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Charles E. Billings

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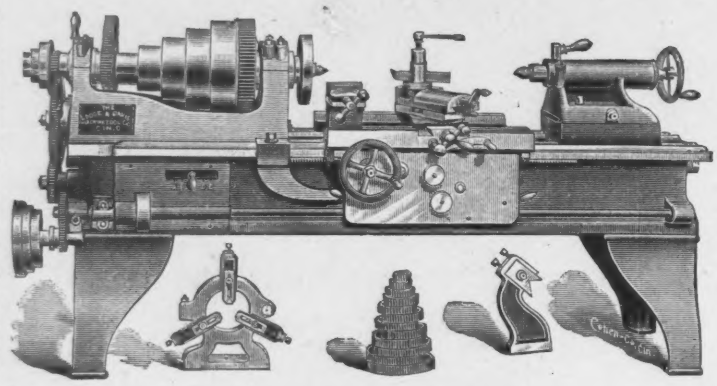

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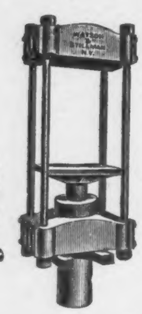

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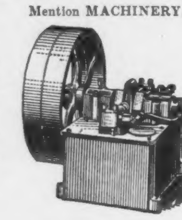

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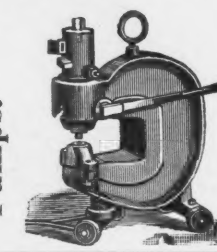

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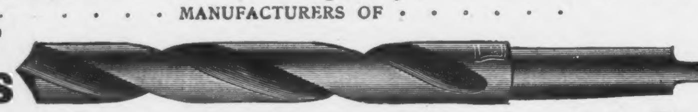

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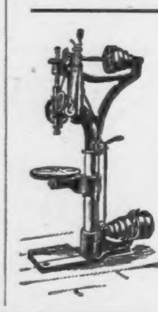

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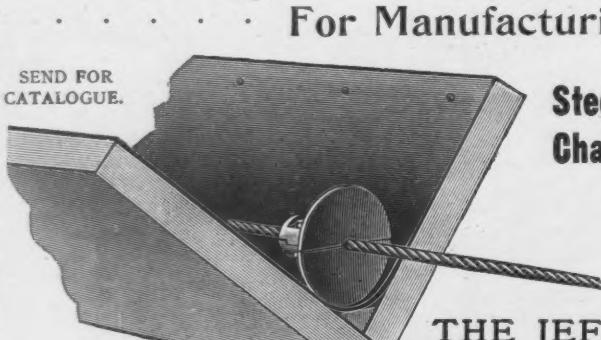

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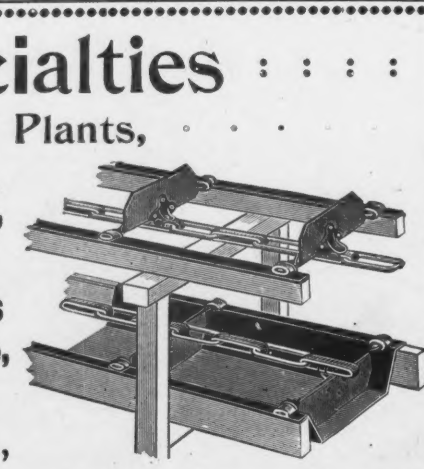

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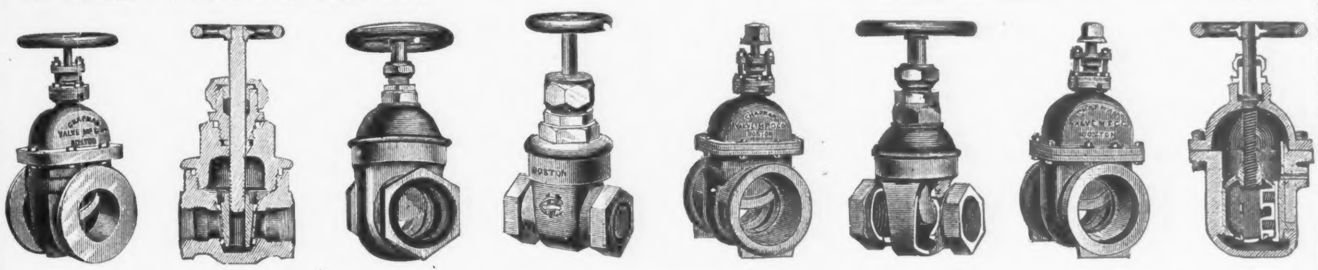

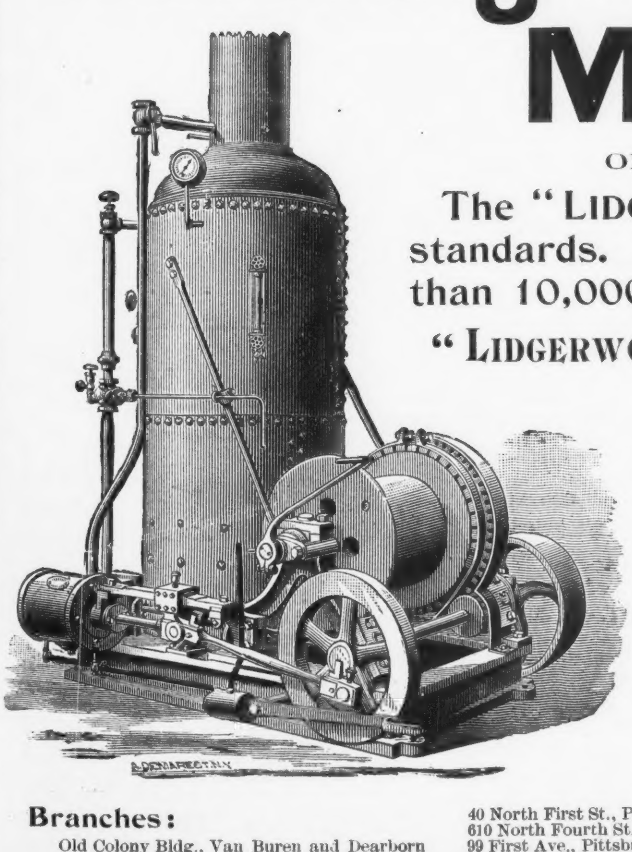

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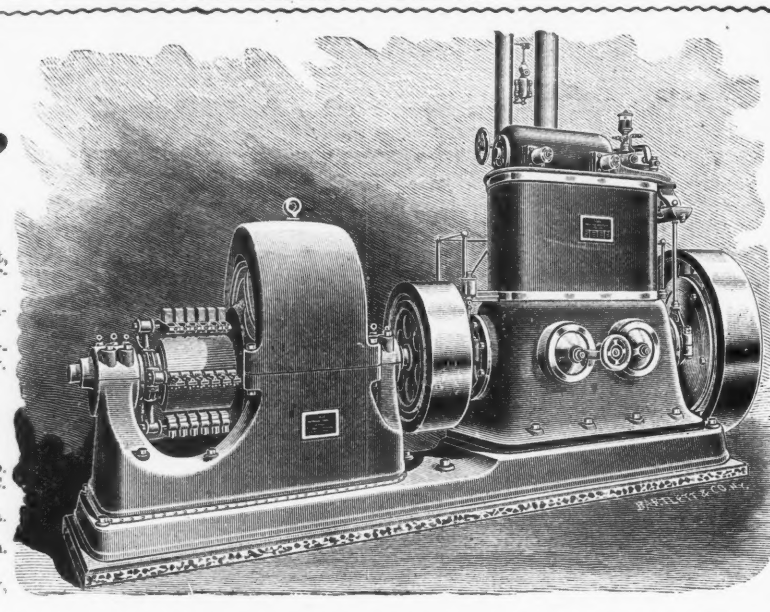

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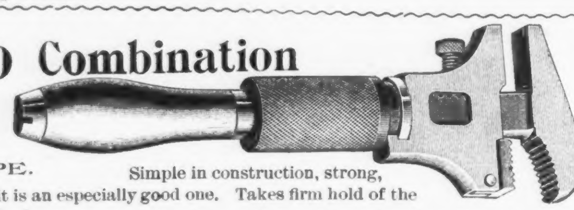

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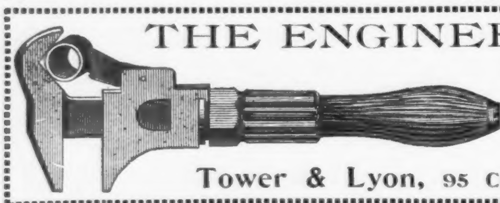

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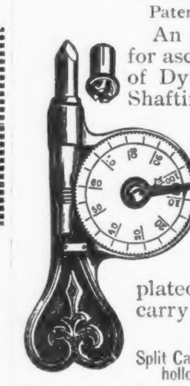

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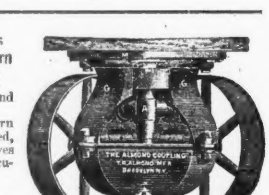

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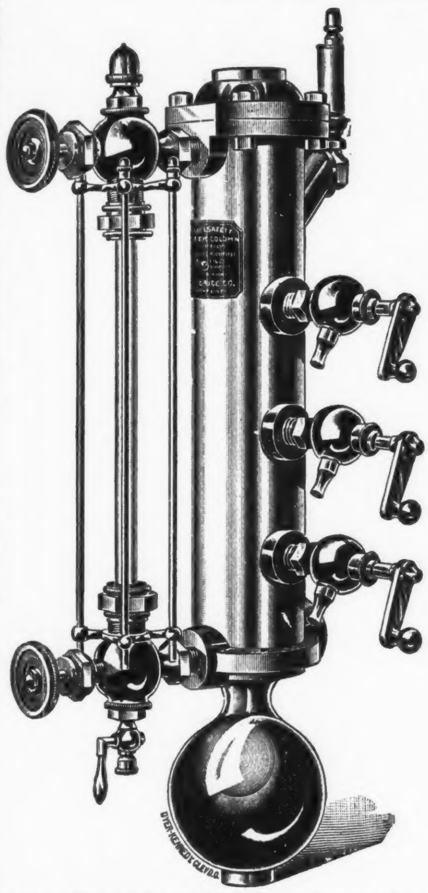

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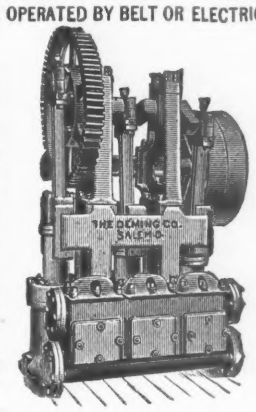

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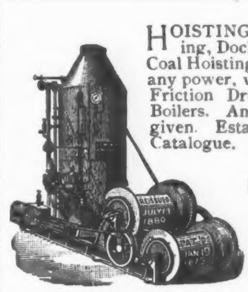

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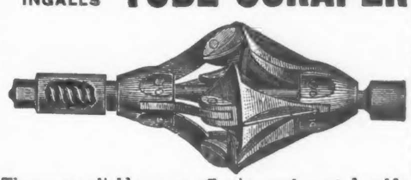

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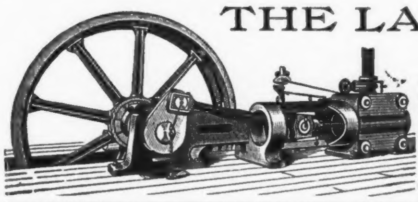

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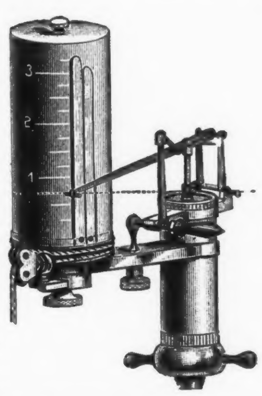

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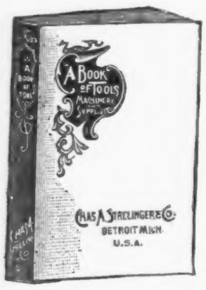

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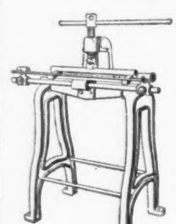

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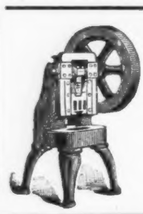

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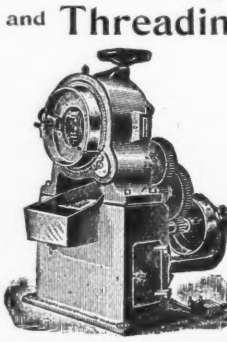

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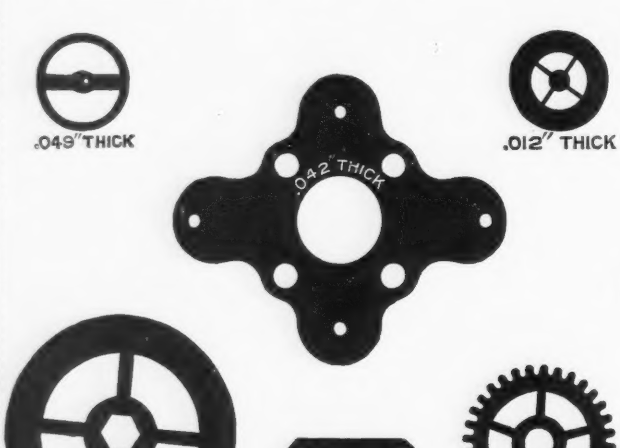

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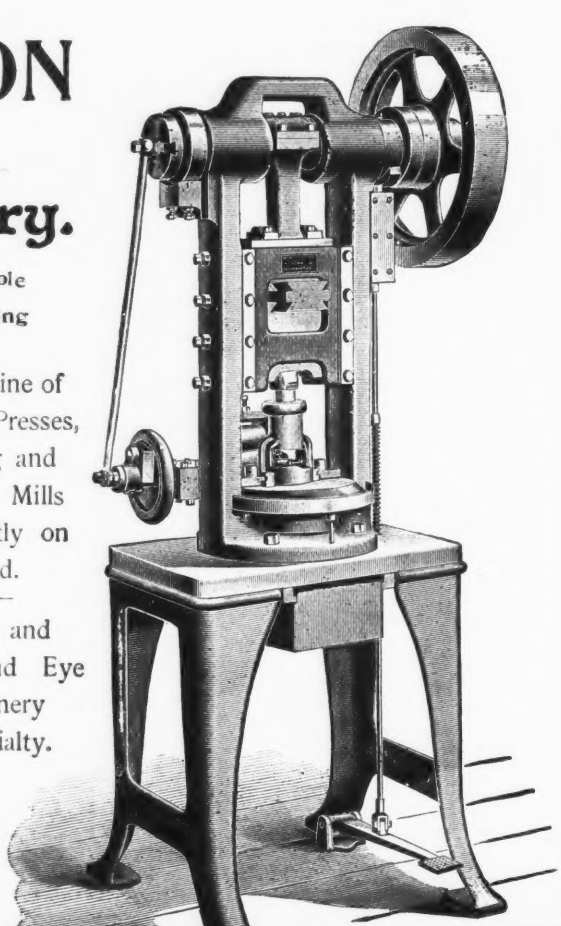


THE CUTS SHOW WORK COMING FROM SUB-PRESS TOOLS, CUT OUT WITH ONE BLOW OF PRESS.

ARCH PRESS FOR SUB-PRESS WORK. MADE IN FIVE SIZES.

MACHINERY.

VOL. I. May, 1895. No. 9.

A BIT OF DROP FORGING HISTORY.

CHARLES E. BILLINGS.

BEING apprenticed in 1852 to the Robbins & Lawrence Company, of Windsor, Vt., it was my privilege to have as a foreman the late Frederick Howe, of Providence, R. I., who later became superintendent of the Providence Tool Company during the war and afterwards held the same position with Brown & Sharpe. Mr. Howe was the designer of many improved machines, such as milling, drilling, rifling and gun-stock turning machines, and I can trace many of his designs in machines of recent date by different manufacturers. It was during my apprenticeship at Windsor that most of the machines were made by Robbins & Lawrence for the Enfield Armory, of the English Government, for the manufacture of the then celebrated Enfield rifle. This was the first attempt of that government in making the parts of their fire-arms on the interchangeable plan, and previous to this time all their arms were made by the "cut and try" method. For example one firm made the barrels, another the locks, still another the stocks, and so on through the list of parts, which were all taken to the Tower of London to be assembled. It was here that the "cut and try" plan played its part, and filing a little here, chipping off a little there, with several trials before the parts would go together satisfactorily.

Charles E. Billings

On the introduction of the special machinery for doing this work, so that different parts could be made exact duplicates of each other, all the cutting, filing and fitting were done away with. To Americans, I believe, is due the credit of introducing the interchangeable system in the manufacture of fire-arms, sewing machines, watches, etc.

After my apprenticeship expired I still remained in the employ of the same firm, in the gun department, on die sinking. It was then I obtained my first insight into the art of forging in dies, which has since been my life study.

The Robbins & Lawrence Company also manufactured a fire arm for the United States Government, known as the Harper's Ferry rifle, and all the forgings for the various parts of this rifle were made by the old method of swaging with dies by hand.

A heavy cast iron block, called the "sow block," with a suitable opening in the top for the lower die, was held fast by keys and stock to guide the upper die termed the "jumper." In the face of the die the forms to be forged were cut as at present, the power being applied by hand hammers and sledges wielded by the smith and his helpers, on the upper die, with the heated bar of metal held between them. Much time was spent in distributing the stock on the end of the bar of metal before the swaging took place, in order to have the metal flow properly to fill the points of the die.

The first drop hammer I ever saw run by belt was built at this shop in 1853. It was a crude affair, with cast iron base and uprights; a shaft at right angles to the uprights carried a loose pulley for a belt and also a spool with flanges for winding the belt. One end of it being attached to the spool and the other to the hammer. A clutch on the end of the shaft, operated by a lever, wound the belt on the spools and raised the hammer, which was held at the height wanted by a dog on the side of the hammer engaging the lever and throwing out the clutch. The hammer was caught by a hook lever and held until the operator tripped the pedal, which was connected by a chain with the hook lever. The descent of the hammer revolved the shaft in the opposite direction, and if the clutch was thrown in before the shaft came to rest it was pretty sure to break it.

In June, 1856, I went to work for the Colt Patent Fire Arms Co. as die sinker in the forging department, and it was here I first saw a practical working drop hammer, designed by the late Elias K. Root, superintendent of the works. This was rather complicated, having four hammers guided by uprights and raised by a vertical revolving screw.

The operator walked around the drop, and in many of the pistol and rifle parts forged used all four hammers, the first one "breaking down," the second for "striking up," the third "trimming," and the fourth "finishing." The machines being complicated made the repairs quite heavy, and later Mr. Root improved them by doing away with the screw and substituting a piston-rod movement, lifting the hammers step by step about ten inches to each revolution of the crank-shaft that drove the lifting bar. This was quite an improvement and reduced the repairs considerably.

The next advancement in this direction was made by Golding & Cheney, who used friction rolls to raise the hammer, a belt being pressed between the two rolls; these being first used by the Spencer Repeating Rifle Co., from 1862 to 1865. These patents

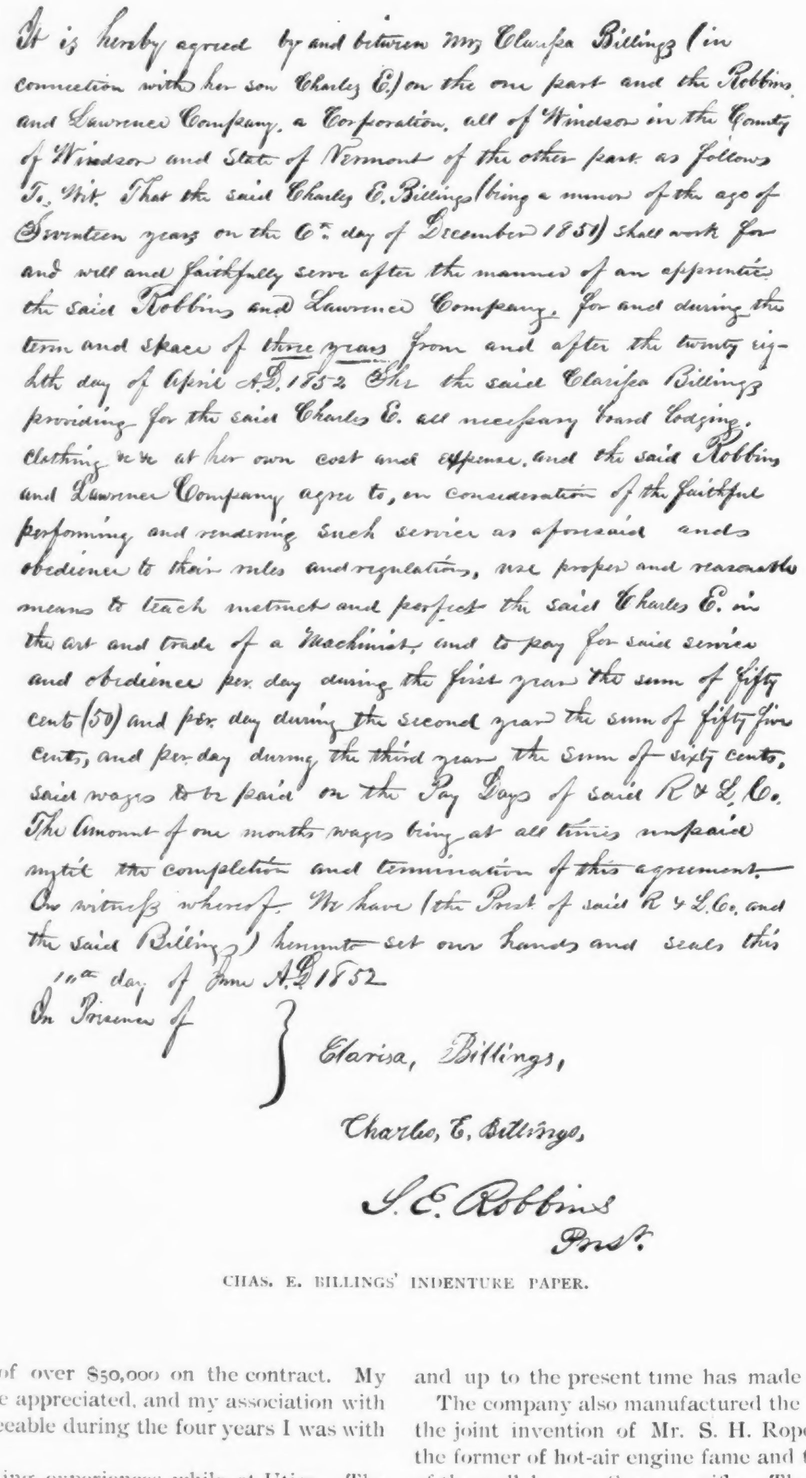
were purchased by the Pratt & Whitney Co., and a large number were furnished the Prussian Government for their armory at Dantzig, Spandau, Erfurt. They are still manufactured in an improved form by this company, and many similar hammers are made by other concerns in various parts of the country.

Having worked six years at Colt's as tool-maker and die-sinker, I closed a contract in the spring of 1862 with E. Remington & Son, of Ilion, N. Y., to furnish them drop forgings for their army pistol, my first contract being for 25,000 sets, which was the first of a total of 280,000 sets. This work was done at Utica, N. Y., a part of the Remington works being located there during the war. On my first contract I used hammers made by Campbell, at Newark, N. J., similar to Mr. Root's last drop, and which were considered superior in many ways, but in my opinion could not compare with it, and gave no end of trouble. Finally in disgust I designed and built drops to replace these, using the Golding & Cheney patents, together with some improvements of my own.

The Remingtons had never used drop hammers in their work, and when the governments required wrought frames for the army and navy pistols, the senior member of the firm thought they might as well give up the job, as they could not be produced by this method of forging.

This resulted in looking for some one versed in the drop forging business, and I was selected for the work. My method of forging the frames for the pistols was a departure from that used at Colt's, and instead of the cylinder opening through the frame being punched out and a dead waste, only fit for the scrap heap, I planned a method of forcing the metal into the frame, thus saving about a pound to each frame; and as all this iron was imported and worth about 20 cents a pound, this was quite an item, in fact a saving of over $50,000 on the contract. My efforts in this direction were appreciated, and my association with the company was most agreeable during the four years I was with them.

I had some very interesting experiences while at Utica. The shop was in the heart of the city, and we ran day and night gangs, producing 400 sets of pistol forgings in twenty hours, each set consisting of eight pieces, which I was obliged to furnish to keep the finishing department supplied. Some of the people in the neighborhood, known as "copperheads," who took no stock in the war to save the Union, thought it was a good chance to strike a blow for the rebellion. So they hunted up some old law and sent me notice to stop running the shop at nights, as it was a nuisance, that we were disturbing the people's rest by the noise of the drops, hammers, etc. I must admit that it was a trifle annoying to those living near the works, but what could we do? The cavalry boys were suffering for pistols and we were doing our best to supply them, and the works must run. The "copperheads" said "Stop," the patriotic people said "Run," and on being questioned by the former as to who gave us orders to run nights, I replied: "E. Remington & Sons, but indirectly Abraham Lincoln," which settled the difficulty, and we had no more trouble.



It is hereby agreed by and between Mrs Clarissa Billings (in connection with her son Charles E.) on the one part and the Robbins and Lawrence Company, a Corporation, all of Windsor in the County of Windsor and State of Vermont of the other part as follows To Wit. That the said Charles E. Billings (being a minor of the age of Seventeen years on the 6th day of December 1851) shall work for and well and faithfully serve after the manner of an apprentice the said Robbins and Lawrence Company, for and during the term and space of three years from and after the twenty eighth day of April A.D. 1852. She the said Clarissa Billings providing for the said Charles E. all necessary board lodging, clothing &c &c at her own cost and expense, and the said Robbins and Lawrence Company agree to, in consideration of the faithful performing and rendering such service as aforesaid and obedience to their rules and regulations, use proper and reasonable means to teach instruct and perfect the said Charles E. in the art and trade of a Machinist, and to pay for said service and obedience per day during the first year the sum of fifty cents (50) and per day during the second year the sum of fifty five cents, and per day during the third year the sum of sixty cents, said wages to be paid on the Pay Days of said R & L Co. The Amount of one months wages being at all times unpaid until the completion and termination of this agreement. In witness whereof We have (the Prest of said R & L Co. and the said Billings) hereunto set our hands and seals this 10th day of June A.D. 1852

In Presence of

Clarisa, Billings,

Charles, E, Billings,

S. E. Robbins Prest.

CHAS. E. BILLINGS' INDENTURE PAPER.

Returning to Hartford in the spring of 1865, I was for three years superintendent of the manufacturing department of the Weed Sewing Machine Co., and introduced drop hammers here for forging several parts of the machines, and especially the shuttles, which were formerly made in several pieces, the outside shell and two end pieces, which were usually brazed in, this being the general process of all manufacturers of sewing machines up to this time. After studying this problem for some time I patented in 1867 a process of drop forging them from a single piece of bar steel, running four pairs of dies for the operation, viz.: one pair for "breaking down," one pair for "striking up," one pair for "trimming," and one pair for "cold pressing." The first two operations were done hot under the drop, the blanks then annealed and the fin trimmed off with punch and die, after which they went to a tumbling barrel, and finally cold pressed in dies by a powerful press. This process reduced the cost of the shuttle 50 per cent., and it has been universally adopted by shuttle makers. Two years later the Billings & Spencer Co. was organized to manufacture these shuttles, and up to the present time has made over four million of them.

The company also manufactured the Roper four-shooting gun, the joint invention of Mr. S. H. Roper and Mr. C. M. Spencer, the former of hot-air engine fame and the latter also the inventor of the well known Spencer rifle. The next year drop forgings were taken up as a specialty, and starting with two drop hammers we have increased to sixty, and are considered by many to be the pioneers in this business. The forging of axes will form the basis for a later article.

* * *

The use of the terms "half-inch *full*" and "three-quarter *scant*" is gradually becoming obsolete, and the sooner the better.

A FEW SHOP NOTES.

"QUIRK."

Most intelligent mechanics I think, know a good thing when they see it; the trouble seems to be to present new ideas and new devices, commonly called "shop kinks," in such a way as to enable a person not familiar with them to fully comprehend their advantages. There can certainly be no better way devised to do this than that which MACHINERY adopts, *i. e.*, to show comprehensive cuts of the various mechanisms submitted. However, with all this, it is frequently difficult to get men out of old ruts in which they have been going for years. We must begin early if we wish to educate a person to use the right hand instead of the left. On the other hand I have often found that *my* pet schemes were not always the best in the world. When I first took charge of a machine shop I was very particular, in giving out work, to instruct the workmen just how it should be done, and nothing was more exasperating to me then, than to find, a little later, that the workman had ignored my plan and adopted one of his own. Even if the work had gone on as expeditiously as I could expect, I was slow to forgive the disregard of my authority. It required some years to convince me fully that my ideas were not always the best, and even now am not always prepared to have my suggestions taken to pieces. Modesty, however, need not deter us from pointing out the faults of workmen as we see them. There is one which I have never heard mentioned in the machine shop, and will venture now to speak of it.

There seems to be a prevalent notion that everything about a lathe, planer, or machine tool of any kind, must be screwed up as tight as the strength of the operator will permit. This doubtless has often been noticed on taking hold of a machine which some Samson has worked on.

Nothing saves bolts being broken, and set screws being pulled in two, or stripped, when in the hands of such men, except that tool-makers are smart enough to protect these parts to the best of their ability by furnishing comparatively short wrenches. A little judgment is a good thing to exercise, when yanking at machine bolts, especially such as the tail-stock bolts of a lathe, which are subject to such frequent use.

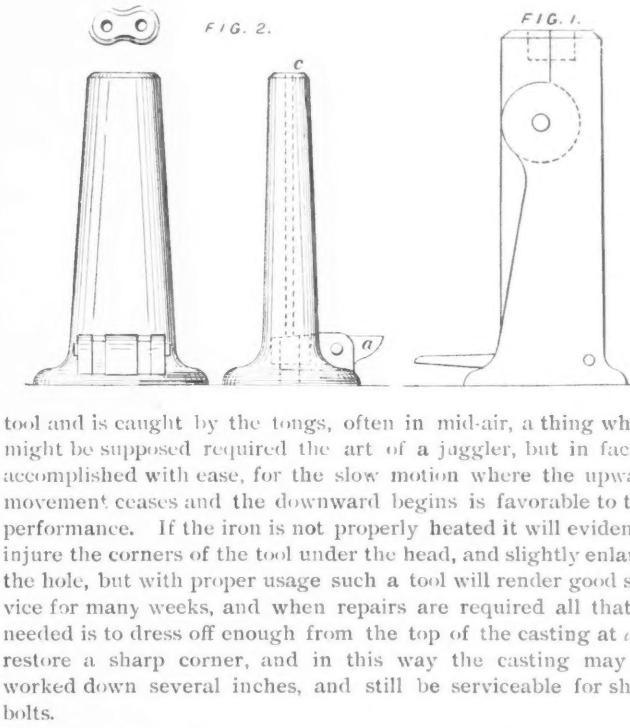
AN active man usually makes a good impression when his abilities as a workman are being sized up, and it is usually a good sign to see a vice hand use the full length of his file, and when chipping take hold of his hammer handle near the outer end. Yet it is well to notice carefully the results of less active persons' movements, for they often possess the faculty of making every lick count, and sometimes fairly lay the hustler in the shade.

I DON'T often go outside the machine shop to speak of "kinks," but will now mention and illustrate a bolt-heading tool which I have found in many respects superior to those in common use, and believe the plan is not generally known.

Before describing my device it may be well to speak of the usual clamping contrivance used for this purpose. As all know, it consists of a heavy upright casting, outlined by Fig. 1, which has an open die at the top suited to the size of bolts being headed. A pedal at the bottom operated by the foot of the smith, clamps the bolt in its place between dies. It is also well known that these dies never fit closely; the severe usage which they get soon causes them to rattle around so as to require shimming, besides they are often driven down into the block, and present an uneven surface for forming the under side of the bolt-head. Again, the imperfect joint between the dies is liable to leave a fin on each side of the bolt.

There is still another fault found in this clamping device. The space for the rod below the dies is at least large enough for the largest size bolt to be made, and consequently when smaller iron is used it is liable to be kinked by the heading operation, and then cannot resist so well the blows of the hammer.

All of the objections I have named are overcome in the simple heading tool shown by Fig. 2. This I have found to work satisfactorily. As will be seen, this tool may be made double, and made to serve for two sizes of bolts. The iron in these tools should be close and strong, the holes drilled the full length and of a size to admit freely the desired size of bolt. The trigger *a* furnishes a support for the backing rod, which fixes the length of the bolt, and also affords a means of expelling the bolt at the will of the operator. To do this it is only necessary to strike the trigger a light blow with the hammer, and the bolt bounds from the



tool and is caught by the tongs, often in mid-air, a thing which might be supposed required the art of a juggler, but in fact is accomplished with ease, for the slow motion where the upward movement ceases and the downward begins is favorable to this performance. If the iron is not properly heated it will evidently injure the corners of the tool under the head, and slightly enlarge the hole, but with proper usage such a tool will render good service for many weeks, and when repairs are required all that is needed is to dress off enough from the top of the casting at *c* to restore a sharp corner, and in this way the casting may be worked down several inches, and still be serviceable for short bolts.

WHILE in the blacksmith shop I cannot refrain from criticising methods employed by some of our worthy knights of the forge. I never could see the use in the owner of a strong arm capable of wielding a hammer effectively, stand by the sparkling iron while his helper plies the sledge, and simply tap the glowing metal where he wants the blow to fall. It seems to me he might just as well lend a helping hand. I have, indeed, seen many examples which proved that two strokes of the hand hammer could be given to one swinging blow of the sledge.

* * *

FOR THE YOUNG ENGINEER—(1).

WM. O. WEBBER.

The stationary engineer who has provided himself with an indicator can go ahead and learn many things about his engine—why it does, and why it does not do certain things, which his brother John's does, across the street.

In the first place he wants a reducing motion to reduce the stroke of the crosshead to the length of his indicator diagram, a simple device and one easily made, is as shown in Fig. 1. Make two strips of hard wood about $\frac{3}{8}$ inch thick by $1\frac{1}{2}$ inch wide; let one of them *a b* be one-half of the stroke of engine in length between holes, or centers, which should be about $\frac{3}{8}$ inch diameter; let the other strip *a c* be three times the length of *a b* between centers. Make a quadrant of soft wood *d e* $5\frac{1}{4}$ inches from hole to edge and fasten this to strip *a c* by two wood screws *f f*. Put up a stick or board *g*, fastened to the ceiling and stayed by braces *h h*[1]; the stick *g* can be 1 by 4 inches if properly braced; suspend the strip *a c* to the bottom of this stick by a $\frac{3}{8}$ or $\frac{5}{16}$ inch "through" bolt, with washers between the stick and strip, also under head and nut on bolt; oil these all well. When the strip *a c* is so suspended the strip *a b* attached

to it should stand level when the engine crosshead is in mid-stroke. Fasten a screw-eye into the edge of the quadrant-block *d e* at *c*; this block should be about 1 inch thick, and the lower edge can be grooved slightly to keep the string or indicator cord in place, but this is not necessary if the quadrant is in line with the pulley on indicator, which it should be, the indicator having been attached to the cylinder properly, and by properly is meant by large enough pipes and long and easy elbows—½ inch pipe and ¾ inch elbows should be used—and if a three-way cock be not available, use steam-plug cocks in preference to globe valves. You are then ready to go ahead and take cards, having selected the proper spring for the indicator; a good rough rule for this being to use a spring that is 10 pounds more than one-half of the boiler pressure, *i. e.*, with 80 pounds pressure use a 40+10=50 spring; this will be all right unless your engine is running over 275 to 300 revolutions per minute, in which case a 60 spring would be better, as it would be less liable to show waves in the admission lines and expansion curve of the card. If, however, your engine is a long stroke low, pressure, say an 18 ×42 with 60 pound steam pressure and 65 revolutions, then an indicator spring of one-half the boiler pressure will be strong enough. Know that your spring is properly adjusted, well oiled and *not cramped* in the indicator cylinder. Work steam through indicator so as to get all the water of condensation out of it and its pipes before taking cards; have a wire hook in the cord attached to indicator drum by a *cramp* knot, so that it can be readily moved. Keep this hook as close to the indicator as possi-

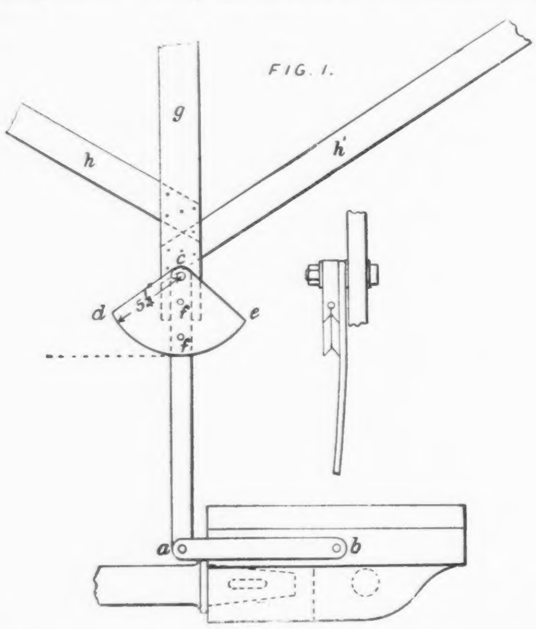


FIG. 1.

ble. In the end of the cord from the reducing motion make a loop about 1½ inch long by tying a bowline knot in the end of same; a knot thus tied will not slip in the loop; pull the hook and cord attached to it as far as they will come, and then catch the loop up under hook, letting both go at the same time. Do not bear on too hard with the pencil-point, as by doing so you are liable to break the point and also to destroy your diagram. Many prefer a brass screw point instead of a pencil, and specially prepared indicator paper. They give a finer line and, when properly done, a sharper diagram, and are generally to be preferred.

After the diagram is taken be sure and draw the atmospheric line, *i. e.*, a line on the card with the steam shut off from the indicator and due to only the atmospheric pressure on the indicator piston. This line gives a base line from which to work in all cases, and should never be omitted.

The common throttling single valve engines generally give a card as shown in Fig. 3, with an initial pressure in cylinder from 20 to 25 pounds below boiler pressure, due to the small steam pipes and also to insufficient area through the usual types of throttling governors. The piston then runs away from the steam and there is very little expansion of the steam taking place in the cylinder. Such an engine is generally using from 50 to 60 pounds of water per horse power per hour and from 7 to 9 pounds of coal, and if the boiler is not condemned as being *too small*, the engine generally wastes enough coal each year to pay for a new one. There is no appreciable point of cut-off to be seen on the diagram, because the steam does *not cut off*, it merely follows along after a fashion as best it can for the whole length of the stroke.

With a card like Fig. 6 you are getting approximately perfect results. The admission line is level with the point of cut-off, and is sharp and well defined. The expansion curve *b c* is nearly perfect, the exhaust opening is clearly defined and the terminal pressure low; the back pressure line *d e* is straight and not much

FIG. 2.

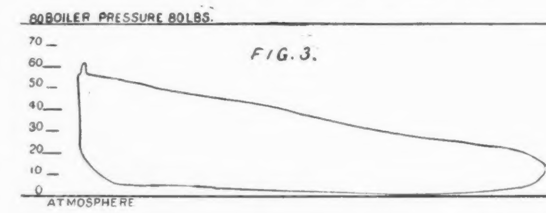


FIG. 3.

above the atmosphere; the compression line *e f a* is good and at proper time. A simple way and one fairly accurate for obtaining the clearance in a cylinder is to draw a rectangular parallelogram *g h i k* at any point (but preferably in the middle) of the compression curve and the base and perpendiculars of the parallelogram to be square with the atmospheric line; draw the vacuum line *m n* 14.7 by your indicator scale corresponding to your indicator spring below the atmospheric line; draw a line *h* R bisecting the two angles of the parallelogram, prolong this line until it cuts the vacuum line *m n* at L; erect a perpendicular L *o* from this point. The distance between this line and the line *f a* repre-

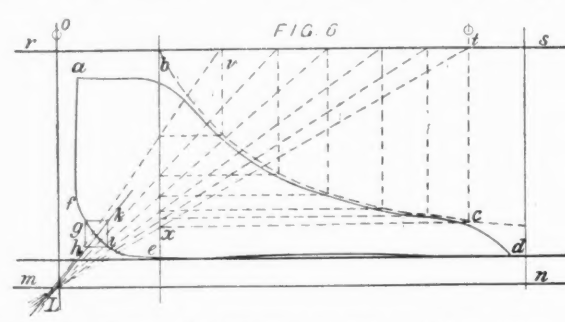


FIG. 6

sents the amount of clearance in the cylinder, the proportion being as this distance is to the total length of the indicator diagram. A reverse diagram and method will give you the clearance at the other end of the cylinder.

The theoretical or adiabatic curve is laid down as follows: Select any point *c* on the expansion line before the exhaust has opened, and from this point draw a vertical line to *t* on the line R *s*, which may be the line of boiler pressure. From *t* draw the diagonal to L, L being the intersection of the vacuum and clearance lines, and from *c* draw the line *c x* parallel with the atmosphere. From *x* to the point of intersection of the diagonal *t* L and the horizontal line *c x* draw the vertical line *c b*, the point *b* is the theoretical point of cut-off. Set any other number of

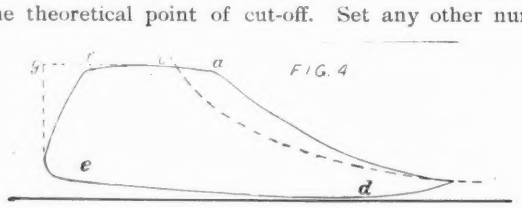


FIG. 4

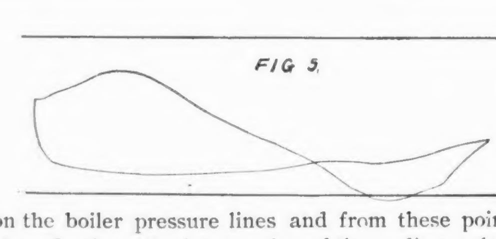


FIG. 5.

points on the boiler pressure lines and from these points draw diagonals to L; from the intersection of these diagonals with *c b* draw horizontal lines and from the points on the boiler pressure line drop vertical lines. Where these lines meet will be points in the theoretical curve. If your diagram does not follow this line pretty closely something is the matter with your engine, and you are wasting power and coal. Other variations in your card from the theoretical are due to bad position of valves, slipped eccen-

tric, or other causes, all of which will show either in the admission line, exhaust line, or compression curve, and it will require some study to readily interpret what these variations from a true diagram mean.

In a diagram like Fig. 4, where the cut-off is better and the card generally better than Fig. 3, we draw our conclusions as follows:

The expansion line is *a b* away ahead of the adiabatic curve *c b*, which shows that the steam valves are leaking badly and steam is being wasted, The slope on the exhaust line from *b* to *d* shows a choked or late exhaust, the height of the line *b e* above the atmosphere, showing excessive back pressure, due to the same cause and also to improper position of the valves, which is also shown by the admission line beginning at *f* instead of *g*, as dotted, the piston having gone that far on its journey before the valve got wide open, either showing that the valves had not lead enough in the first place, or the eccentric or valve-rod, probably the latter, had been moved, and the engine was "blind." When you obtain a diagram like Fig. 5 you can readily assume that your eccentric has slipped around on the shaft, and usually an engine in this condition would pound so as to be heard a block away, run hot and waste as much steam as it uses.

* * *

LUBRICATING OILS AND LUBRICATION.

"Bell Crank."

One of the most difficult things that a mechanic or engineer is asked to do, is to decide which is the best for his purpose among the many kinds of oil now offered for every purpose. The manufacture of oils has reached a stage which enables the maker to produce any kind of oil that is needed, if the user can succeed in giving to the maker an intelligent specification of what is wanted. Therefore, if an oil has not been found which is best for a given purpose, it is generally because the user does not know how to select and specify what is wanted. Many attempts have been made to devise a practical test for determining the quality of oils, so that a selection could be made for any given purpose; but no such comprehensive test as this has yet been devised.

The engineer is yet obliged to use the universal and venerable "rule of the thumb" in deciding on a suitable oil, by trying one kind after another on the thing he wants to lubricate, until he discovers one that will do. Having thus settled the matter, it is very difficult to induce him to make any further trials of other oils, because he knows he could not live long enough to give a proper trial to every kind that is offered by the ubiquitous oil man, and he is therefore content to let good enough alone. Every oil manufacturer in the country can show genuine testimonials from good engineers and mechanics who say they have tried their oil and find it "very satisfactory," or it gave "satisfactory results." Such testimonials are of no value whatever to an engineer in aiding him to decide on an oil, unless he can obtain accurate and complete information in regard to the conditions under which it was used, and even then it does not answer the main question; and that is whether it is the cheapest oil that can be had that will rightly serve the purpose. The only thing such a recommendation means is that the engineer who tried it happened to get that particular oil which served his purpose, and he will not try any other as long as it will do; but a dozen other makers may produce an oil just as suitable and perhaps cheaper, though he does not know it by trial, and therefore does not recommend it. Prof. J. E. Denton made the most comprehensive series of experiments yet made with oils, with a view of determining the qualities required by lubricants for different purposes, and he embodied the results in a paper presented to the American Association for the Advancement of Science. I will try to present the conclusions in a concise form, with some comments, for I think it will help clear away some of the errors about lubricants which are accepted as facts by many.

So far as lubricating quality alone is concerned there is very little, if any, difference between the thickest cylinder oil and the thinnest spindle oil. The conditions of the experimental proof of this were a smoothly polished car-axle journal run at maximum railway speed, loaded to a pressure of 5,000 pounds per square inch and copiously lubricated by a saturated pad bearing against the lower side of the journal. Even the lightest spindle oil run for hours under this great pressure with the minimum amount of friction. Common experience in the use of oil seems to flatly contradict this, for it is found impossible to lubricate heavy machinery like rolling mills with the light oils. Evidently it must be some other quality than that of lubrication which makes thick oil the best for such purposes. This brings us to the consideration of two other important qualities of oil. First: Viscousity or stickiness. Second: Capacity to resist decomposition by heat.

Viscousity is of value in causing the oil to cling tenaciously to a bearing when applied and thus prevent it from rubbing dry easily. Its disadvantages are, that it causes more friction than thin oil, and that it is sluggish in getting to all parts of the bearing and difficult to feed with regularity. This quality is the element of success in lubricating heavy journals exposed to dust and grit, and to which the oil is usually applied at irregular intervals.

The capacity to resist decomposition by heat is a quality the value of which is easily seen in the use of oils for steam cylinders, where only those that stand the heat of steam are of value as a lubricant. This value is not so obvious, but just as important at times in the lubrication of journals; for an oil that will stand a high temperature will permit a journal to run for a time much above its normal temperature without destroying itself, where an oil which decomposes at a lower heat would fail to lubricate. In the lubrication of engine journals and crank-pins the chief desire of the engineer is to have an oil that is thin enough to feed perfectly regular and prevent overheating the bearing. When oil is supplied with certainty to all parts of the bearing, and it is not overloaded, it will not overheat unless something disturbs the condition of its surfaces. The ordinary wear of the journal may in time so destroy its truth as to cause overheating, but this can generally be detected before it reaches a crisis, because it will attain this condition gradually, and its daily temperature will be increased so it can be detected. It sometimes occurs that, although a bearing has been kept thoroughly oiled all the time, it some day suddenly overheats without any visible cause. This is most likely due to a gradual change in a part of the bearing, due to wear caused by access of dust or grit in the oil, which abrades a portion of the bearing and prevents the oil from reaching it freely. The most perfect method of oiling is of course the continuous circulation method, in which so much oil flows through the bearing that it not only insures thorough lubrication, but washes out the fine particles which are worn off the surfaces. Whenever possible to apply it this is the most economical way of using oil, because it never wears out the oil; the only losses being that due to evaporation and what is absorbed by the dust and particles worn from the bearing. The oil for this purpose should not be any thinner than is required for a free flow through the bearing, because usually the thinner an oil is the lower its temperature of decomposition.

For vertical flat sliding surfaces oiled by a drop feed, the most viscous oils are the best, for the thin oils rub off so quickly that it requires a much larger quantity to keep it oiled. It may be stated as a general proposition that in all bearings which are oiled by the drop feed instead of circulation, the most viscous oil that can be fed with reliable regularity will be the safest and cheapest, if the increased friction due to viscousity is not a large percentage of the total power used.

The capillary property of oils no doubt has an effect on their rate of distribution on a bearing, but there is probably not enough difference in oils of the same viscousity to be of any importance. The most viscous oils will distribute on close fitting journals, but it takes many times longer for it to spread over the surface than thin oil, so that its rate of feeding cannot be increased at will in case of heating.

Vegetable and animal oils of some kinds dry out and leave a residue which clogs up oil holes, or, in shop language, it "gums up the bearing." Of course such oils are not suitable for a lubricant, but it is a quality which may be detected by a simple test.

In conclusion it may be stated that the best oil for a bearing must have the following qualities: First, it must have no more viscousity than just the amount required to keep it on the bearing surfaces. Second, its temperature of decomposition must be as high as possible, consistent with the required viscousity. Third, it must be absolutely free from grit or dirt and destructive acids. It must be understood that the limit to viscousity is imposed only because it interferes with regular feed and free distribution over bearing; and in case of light machinery, because it increases friction; but if these factors do not require consideration, then the most viscous oil will likely be the best to use.

SOME PECULIAR CARDS.

GEO. GUNTZ.

Some few years ago I was called to examine a 16 by 24 inch slide-valve engine. The particular cause of this call was that the party owning the engine had added another machine to the plant driven by this engine, but the engine wasn't equal to the occasion, and yet it was supposed from its size to be amply large to develop the required additional power. Well, I went and had a look at the outfit and came at once to the conclusion that there was a "nigger in the fence" somewhere, and after watching the exhaust for a few strokes I came to the conclusion that the somewhere was under the steam-chest cover; so I took that off and, sure enough, there he was in the shape of 3/8 inch of steam lap. This I found after a little further search was caused by the eccentric having been set wrong. I did not at once adjust the eccentric, because I had a curiosity to see what kind of a card would be the result of such a condition. I then had the cylinder drilled and tapped for indicator fixtures, and the cards in Fig. 1 are the result. Then I adjusted the eccentric to its proper position and the cards in Fig 2 were obtained; and finally I took a quarter of an inch from each side of the exhaust cavity of the valve and an eighth of an inch from each end of the valve, and this resulted in the cards shown in Fig. 3.

Now it is just possible that some one had been tinkering with the eccentric; but I know that the valve had not been molested since the engine left the shop. Now, while the rods, crank and

FIG. 1

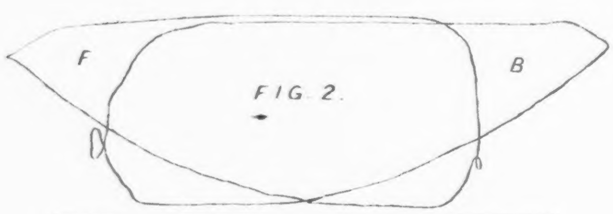


FIG. 2.

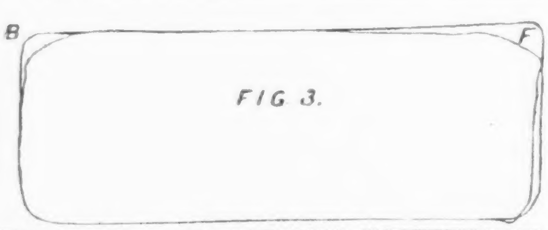


FIG 3.

shaft were all pretty well proportioned, there seemed to be a lack of knowledge on the part of the builders of what should happen inside of the cylinder, and yet the concern who built this engine were a pretty large concern, who built a great many engines, all the way in size from 6 by 12 inch to 30 by 72 inch; and yet up to this time it was not known that they had ever put an indicator on one of them. *But they do now.* But it was the same old story: the rut was pretty deep and they could not get out until they ran up against an obstruction for which they had either to pull out or burst, and eventually such an obstruction came along in the shape of having one of their 18 by 36 inch engines displaced by another party's 12 by 20 inch; then they came to the conclusion that there was something more in mechanical engineering than running a chipping hammer, a bull-head lathe, or a jackass planer. Now let us get back to the cards and see if there isn't.

This engine had 11.2% clearance. In the diagrams in Fig. 1 there is a difference in their length; there is also a difference in their general shape and in the indicated pressure. In the diagrams in Fig. 2 these differences are also observed, but they are not so great. In the set in Fig. 3 there is also a difference. The conditions under which these diagrams were taken are: Scale of spring, 40; boiler pressure, 50 pounds; revolutions, 90, for the first set For the second set: Spring scale, 40; boiler pressure, 60; revolutions, 80. Third set same as second; indicator worked with lazy tongs.

Why is one diagram larger than the other? Why is the steam line in the front end of the first set about ten pounds higher than in the back end? Why was the change in the general shape of the diagrams in Figs. 1 and 2 so slight? What is the difference in the diagrams in Fig. 3? Who knows, and how do you know?

* * *

THE DESIGNING AND CONSTRUCTION OF MODERN STEAM ENGINES.—8.

THEO. F. SCHEFFLER, JR.

CONNECTING-ROD CONCLUDED.

We will first calculate the diameter of crank-pin, assuming that pin is made of best selected hammered steel, using the following formula:

Let D=diameter of pin in inches.
" P=maximum pressure on connecting-rod due to angularity of rod.
" l=length of crank-pin in inches.
" f=factor of safety.
" 5.53=a constant.

Therefore,
$$D=\sqrt[3]{\frac{P\,l}{f}}\times 5.53+.7$$

Let P=25476.75.
" l=6.
" f=9000 for steel (5000 for wrought iron).

Then
$$D=\sqrt[3]{\frac{25476.75\times 6}{9000}}\times 5.53=4.5468+.7=5.2468$$

inches diameter for crank pin; this is practically equivalent to 5¼ inches, and makes a large and generous pin. For ordinary engines, for rapid calculation, the diameter of pin may be taken as one-quarter of the diameter of cylinder plus ½ inch; this, however, would not do where a high initial steam pressure is desired. Where the diameter of crank-pin is known, the length may be obtained by multiplying diameter by 1.15. The projected area of pin is length multiplied by diameter: therefore 6×5.25=31.5 square inches of projected area; and as we have a maximum pressure of 25476.75 pounds, dividing by 31.5 gives 808.7 pounds pressure per square inch of projected area. The pressure per square inch allowable for projected area of crank-pin is from 700 to 900 pounds; it will therefore be observed from the above results to be within the margin of safe limit. While we would prefer 700 pounds, the 808.7 is practical.

To determine the amount of horse power absorbed by friction of crank-pin rubbing on connecting-rod brasses, we will apply the following formula:

Let H=the horse power absorbed.
" f=co-efficient of friction between the two surfaces.
" W=the average total pressure on connecting-rod throughout the stroke at 81 pounds M. E. P. on piston and neglecting angularity of connecting-rod, as this only complicates the formula.
" S=revolutions per minute.
" .26=a constant.
" d=diameter of crank-pin.

Therefore
$$H=\frac{f\,W\,S\times .26\,d}{33000}$$

Let f=.0325 for perfect lubrication of crank-pin.
" W=16285.8.
" S=170.
" d=5¼.

Then
$$H=\frac{.0325\times 16285.8\times 170\times .26\times 5.25}{33000}=3.72\text{ H. P.}$$

absorbed by friction of crank-pin in connecting-rod box. This is comparatively small when considering the excessively high M. E. P. throughout stroke; this is also the greatest amount of friction that has been calculated on this engine. The percentum of power may be calculated from the following formula:

Let P=percentum or power.
" H_1=horse power absorbed by crank-pin.
" 100=constant representing 100 per cent.
" H=horse power of engine.

Therefore
$$P=\frac{100\times H_1}{H}$$

Let H_1=3.72.
" H=335.58 H. P. at ⅓ cut-off.

Then
$$P=\frac{100\times 3.72}{335.58}=1.10$$

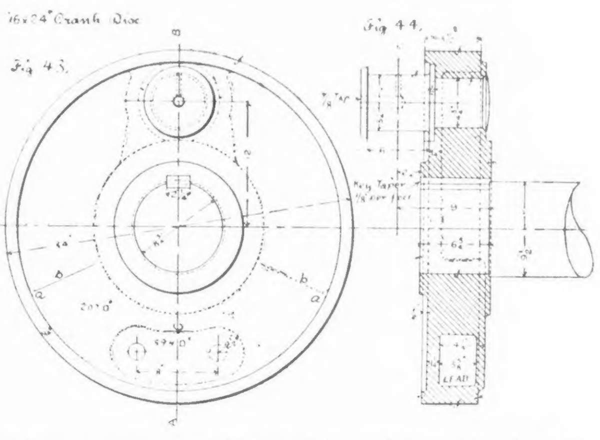
per cent. of total horse power expended in friction of crank-pin and connecting-rod box.

We will now calculate the counterbalance weight of engine at 170 revolutions per minute, but it will first be necessary to know

the approximate weight of all parts to be balanced; all that is balanced is one-half of all reciprocating parts, such as crosshead, piston and rod; also one-half of connecting-rod, *i. e.*, the heavy end of rod which is on the crank-pin end, and all of the crank-pin and boss in crank-disc. As the weights of piston, crosshead and connecting-rod are known, we will figure weight of crank pin and boss. The diameter of crank-pin is 5¼ inches, but allowing for collar the average diameter will be approximately 5½ inches; the area of 5½ is 23.75 square inches; the length of pin over all is about 12 inches, and multiplying $23.75 \times 12 = 285$ cubic inches; this multiplied by .28 gives 79.8 pounds for weight of crank-pin. The diameter of crank-pin boss should be about double the diameter of crank-pin, which would make it 10½ inches diameter; the area of 10½ is 86.59 square inches, and deducting out area of 5¼, which is 21.64 square inches, we have $86.59 - 21.64 = 64.95$ square inches in boss; the hub in disc is 4 inches long, and multiplying $64.95 \times 4 = 259.8$ cubic inches in boss; this $259.8 \times .26 = 67.54$ pounds for crank-pin boss. We now have all of the necessary weights. Referring to back numbers of MACHINERY we find the weights of crosshead, piston and connecting-rod:

	Pounds.
Weight of one-half of piston,	=101.28
" " " " piston-rod,	= 42.39
" " " " crosshead and gib,	=165.00
" " " " wrist-pin and nut,	= 16.2
" " " " connecting rod, large end	=140.
" " whole " crank-pin,	= 79.8
" " " " crank-pin boss,	= 67.54
Total	=612.21

To have an engine that is thoroughly counterbalanced, we



must have a counter-weight equal in weight to the above 612.21 pounds; that is if the center of gravity of counter-weight is the same as the center of gravity of crank-pin; if not, then the weight must be equivalent to the above weight; if counter-weight center of gravity is closer to center of shaft than crank-pin center, then we require more than our 612.21 pounds to balance perfectly. It is almost next to impossible to get the required weight in counter-weight, but where we fail to obtain the desired weight when counter-weight is made of cast iron, lead will help us out, by coring out counter-weight and filling cavity with lead. Having determined the outside diameter of crank-disc, it is necessary to locate the counter weight and also decide upon the shape of it, so that the center of gravity may be located. Having found the center of gravity we can proceed with calculation of counter-weight.

In order that the reader may become perfectly familiar with design of crank-disc and pin, we will refer to drawing. Fig. 43 is the side elevation of disc as seen when in proper position in engine bed; Fig. 44 is a vertical section on line A B, through center line of crank-pin boss and center of shaft. The counter-weight is shown by dotted lines *b b*, in Fig. 43, also the shape of cavity to be filled with lead. The center of gravity of a counter-weight in one segment can be obtained mechanically by cutting out a wooden or paste-board templet of uniform thickness; the templet should have the exact shape and outline of counter-weight. Having the templet made, suspend it by one of the corners *a*, as in Fig. 43; a plummet-line dropped from the same point of suspension in front of the templet will intersect the center line A B at the center of gravity C; this distance as found as described above is 10 inches from center of shaft. The area of segment or counter-weight can be best found with a planimeter; the area is required in order to determine exact weight of counter-weight. This area as found with planimeter equals 207 inches, and thickness of counter-weight is 4¼ inches. The area of cavity to be filled with lead is 59.4 square inches, and thickness of lead counter-weight is 3⅝ inches. As we have 207 square inches and multiplying by 4.25 inches gives 879.75 cubic inches, this 879.75 multiplied by .26 gives 228.73 pounds for weight of counter-weight. As we have 59.4 square inches for area of cavity filled with lead, we multiply $59.4 \times 3.625 = 215.32$ cubic inches; this $215.32 \times 15 = 32.29$ pounds additional; as lead weighs .41 pounds per cubic inch, deducting .26 from .41 gives .15 pounds over and above what cast iron weighs; so that by adding 228.73 to 32.29 gives the equivalent amount of counter-weight for cast iron and lead together; this gives us 261.02 pounds total weight for counter-weight. As we have 612.21 pounds to be balanced, divide 612.2 by .833 feet = 734 pounds, which is equivalent to the 612.21 pounds when placed at the center of gravity; the .833 is the distance in feet from the center of shaft to center of gravity of counter-weight. The center of gravity will be somewhat increased on account of using lead, and will probably be about 11 inches instead of 10. Assuming it is 11 inches and dividing 11 by $12 = .91$ feet, and dividing 612.21 by $.91 = 672$ pounds required in counter-weight. The reader can now obtain an idea of the difficulty met with in trying to balance reciprocating parts. It has been found by actual experience, however, that if we obtain from 40 to 50 per cent. of total of actual weight required the engine will run steady; then again the counter-weight is augmented somewhat by weight of eccentric and strap. Another way the weight may be increased is by using a very large crank-disc, which will throw the center of gravity further from the center; but this has a disadvantage of either cutting through the bottom of bed for disc, or increasing the distance from bottom of bed to center of shaft; some builders have adopted the former plan. The disc as designed for the engine will, in the writer's opinion, give good results, and may be still bettered by coring out the entire counter-weight and filling with lead. To calculate what the centrifugal force of reciprocating and revolving parts would be at 170 revolutions, we will apply the following formula:

Let W = weight of reciprocating and revolving body in pounds.
" D = radius from center of shaft in feet.
" R = revolutions per minute.
" C = centrifugal force in pounds.

Therefore $C = .000341 \times W \times D \times R^2$.

The constant .000341 is the unit of centrifugal force; or, the centrifugal force of one pound making one revolution per minute, in a circle of one foot radius, is .000341 of a pound.

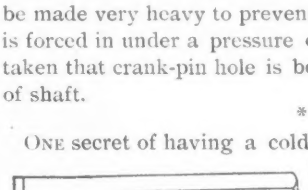
Let W = 612.21 weight of reciprocating and revolving parts.
" D = 1.
" R = 170.

Then $C = .000341 \times 612.21 \times 1 \times 170^2 = 6033.26$ pounds total centrifugal force. By dividing 6033.26 by 201, the area of piston, we obtain the pressure per square inch that will furnish the above centrifugal force; $6033.26 \div 201 = 30.01$ pound. This pressure is comparatively small, but it is increased by the square of number of revolutions. For instance, if we double the number of revolutions and make it 340, it will be 4 times 30, which is 120 pounds per square inch. This amount should be avoided; the 30 pounds can be considered as practical.

A few more words in conclusion of crank-disc. The overhang of crank is reduced to a minimum, being about two-thirds the diameter of shaft; this distance has proved to be satisfactory on heavy duty engines, and the crank-disc never gets loose. The crank-pin should be drilled and tapped for ⅞ hole to oil crank-pin with a centrifugal oiler, which experience has taught to be the best method for oiling crank-pin. A pressure of about 70 to 80 tons is used to force crank-disc on to shaft. The hub should be made very heavy to prevent splitting of disc. The crank-pin is forced in under a pressure of 12 to 15 tons. Care should be taken that crank-pin hole is bored perfectly true with center of of shaft.

* * *

ONE secret of having a cold chisel hold its edge," said an old bench hand, "is to grind the cutting edge to a little sharper bevel than the whole point. This gives more strength to the edge than when it is a long slim taper." The cut shows what he meant, after grinding or forging the chisel, sharpen as shown at *a*, by a sharper bevel.



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DAVID M. MALONEY,
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MAY, 1895.

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We will furnish without charge to readers of MACHINERY, the name and address of any desired manufacturer of machinery, tools, or appliances.

We observe with satisfaction that our contemporary the *American Machinist* has followed us into the advertising columns of several well-known trade journals, and pays us the additional compliment of following also our style of advertising. We extend our congratulations to the *Machinist*, as well as to its readers, on the improvement in that paper since the appearance of its "infant contemporary." The man who remarked that "competition is the life of trade," was no fool.

CLEANING MACHINERY.

Clean machinery will produce more and better work than machinery which is allowed to accumulate oil and dirt on all parts not kept clean, or partly so, by the operation of the machine itself; and the best workmen will, as a rule, keep their machines in good order if allowed time for it, which too many economical (?) managers do not consider necessary. There is another extreme, however, which is not only wasteful of time, but a positive injury to the machine, and should be discouraged or forbidden. This is the practice of indiscriminately "scouring" every finished part of a machine, the idea being to have it look "nice," regardless of the effect on the working surfaces. The shears or ways, of lathes, planers, etc., get plenty of wear doing regular work, and the use of an abrasive on any working surface is not good practice.

* * *

SOME MODERN TENDENCIES.

The days of shops for general machine work that manufacture anything from a tap to a steam engine are numbered, and in their place we find, in constantly increasing numbers, shops to manufacture only one line of tools or several kindred lines. All the energy and ingenuity of the establishment is thus concentrated in one channel, and every detail receives careful attention. Then, too, the increased number of machines produced, renders possible the use of special tools which could not be economically employed in a smaller business or on a larger variety of work.

In many large shops this rule may apply to departments, provided each is in charge of a competent man and devoted in one sense exclusively to its particular branch; the whole being under one general superintendent, who possesses the ability to accurately determine the limits of each department, so that every tool may be worked to its full capacity. Specialties are plainly the order of the day, and an exaggerated example of the modern tendency is shown in the facetious remark of a well-known shop manager, "The time is coming when a shop will make nothing but 30-inch pulleys, 6-inch face, with 2-inch hole in hub, and when a telegram comes, saying 'Send me six by express,' they will know just what to send, as they make nothing else."

The amount of work it is possible to obtain from the large machines is another item of vast importance to every shop. Some of these tools represent an investment of thousands of dollars, and they now ordinarily stand idle at least fourteen hours a day. The speaker just referred to added: "Before many years these large tools, if not the entire shop, will be run twenty-four hours a day, with three shifts of men working eight hours each," which will vastly increase the output of the machines and be easier on the men than at present.

Both of these statements are in advance of the times, but they are the logical outcome of modern tendencies, and are being followed to a considerable extent in the development of modern shops.

* * *

THE cost of all kinds of machinery and tools has been so greatly reduced in this country within the last two years that many foreign markets which have heretofore been closed to our manufacturers are now open to them; and to enable them to take advantage of these changed conditions a foreign edition of MACHINERY is being prepared which will reach the larger manufacturers and dealers in Great Britain, France, Germany, Belgium, Holland, Austria, Russia, Spain, Switzerland, Sweden and Norway, Italy, Australia, Japan, China, India, and South and Central America.

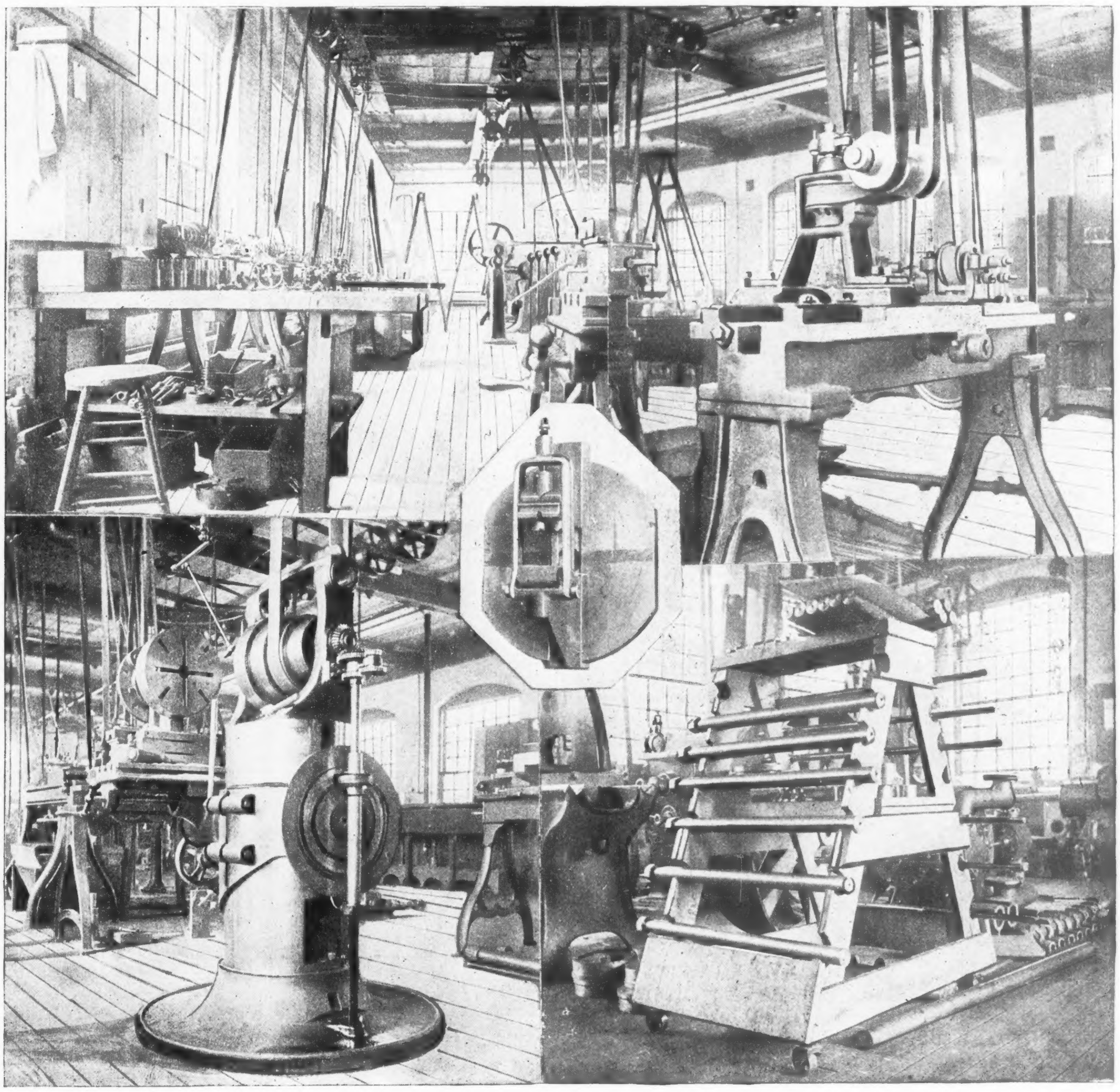
MACHINERY has already a steadily increasing circulation in many of these countries.

ANOTHER MODERN SHOP.

Fred H. Colvin.

It is quite refreshing in many ways to visit a shop like that of W. D. Forbes & Co., and note some of the many good features that exist there, both mechanical and social, if they may be so called. In the first place the shop is a very light one, being "85 per cent. light," as Mr. Forbes expressed it; and as the windows are kept clean, this percentage is a fairly constant quantity. The absence of posts or columns is very noticeable, and the room saved, as well as the freedom from shadows they produce, makes one wonder why the plan of supporting the floors from the roof is not more generally adopted. This of course requires walls and roof girders to be strong enough to support the second floor and all above it, but this is done successfully in large public buildings, and can be easily accomplished for ordinarily light machine work, the heavy work being done on the ground floor. One of these rods can be seen at the right of the special milling machine in the upper right-hand corner of the group. This machine is rigged up for special work and has three spindles, the vertical one in the foreground and two horizontal spindles in the rear set exactly in line so that any shaft can be splined on opposite sides at one setting, the spindles being adjustable for depth of cut, etc. The benches are arranged somewhat differently from most shops, for instead of running along the walls in front of the windows, they run out from the wall between them, thus giving a man a chance to work on either side, and affording him good light in both positions, at the same time allowing lathes to be set between them and near the windows, as shown in the upper left-hand view. This makes a very good arrangement of benches, and the nearest approach to it that I know of is the independent ones shown in the views of the Pedrick & Ayer Company's shop in the January issue. Both the arrangements are good and can be used to advantage in almost any shop.

It is a trite saying in many shops that anything you can turn is cheaper than any other mode of fit or finish, and except in a few special cases this is true in machine shop practice. Working on this line Mr. Forbes designed and built a milling machine for his own use some years ago, which is shown in the lower left-hand view of the group. The base is a hollow cylinder, as shown, and the knee and table fit around this with the large bearing sleeve, which gives a very firm bearing, and is clamped by the binding bolts shown. The horizontal bearing is also cylindrical, with internal ribs for stiffness, resembling in this respect a Serve tube, and the whole machine is one of the most convenient and solid millers that I have seen. The vertical movement is obtained by the ratchet shown at the top, although at first this was performed by power, but in practice the use did not warrant the extra complication, and it was abandoned. All screws are graduated for micrometer measurement, as is customary now in high grade machinery, and the machine has been so satisfactory



SOME VIEWS OF ANOTHER MODERN SHOP.

in his own use that Mr. Forbes has several under way for other parties. It may be interesting to note in connection with this that when preparing some standard pieces of aluminum for special purposes, this machine was the only one in the shop which would mill without chattering, and to do this it was necessary to keep the metal thoroughly lubricated with benzine or turpentine, as if allowed to become dry in the least, it would tear and rough up badly. The metal is so susceptible of slight vibrations that it was necessary to station a man at the head of the stairs, about twenty feet from the machine, to prevent any one coming up during a cut, as the very slight vibration would make itself known and felt in the measurements.

It is often a question in small shops, or large ones for that matter, to know what to do with finished pieces of work, for stock rooms with racks which will keep such pieces separate and safe are not available except in a very few instances.

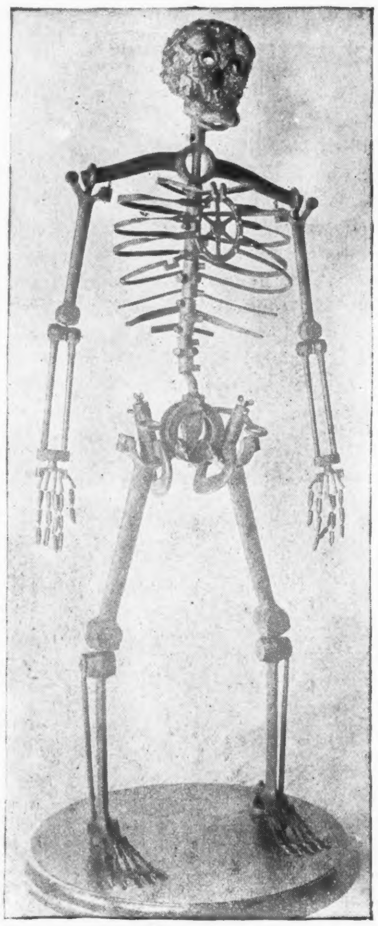
A very neat way of disposing of these at little cost and without occupying an undue amount of room is shown in the other view of the group, the triangular rack, mounted on generous sized castors, which allow it to be moved where wanted, forms a safe and convenient place for piston and valve rods and similar work, keeping them where they are accessible and out of danger of bruising. These can well find a place in almost every shop. The central picture shows what is perhaps the simplest and most sensible two-jawed chuck I have ever seen for the special work for which it was designed, and the idea is applicable to many other places also. As will be seen, there is no central screw as usually employed to move the jaws, but instead the jaws are placed in such a position in the slot as the work demands to have it run true at the outer end. The upper jaw is then clamped in position or held by a pin at the back, and the work fastened by moving the screw in the yoke, which draws the lower jaw up against the work and overcomes any spring of the jaws, as the screw is just where the work is held and not four or five inches to the rear, as is too often the case. When work is once centered it is only necessary to move one jaw, and by loosening the screw the lower jaw moves away from the work, releasing it, and is as readily tightened on the next piece. The main feature is in putting the screw where it belongs, where the work is to be done; and while this cannot be done in all cases, especially where the chuck is used for a large variety of work, the idea can be carried out in many cases and is the correct principle, to be followed as closely as possible.

One subject of conversation with Mr. Forbes may be of interest to others as it was to me, and shows that electric welding does not possess all the virtues that it seemed about to bestow on the mechanical world a few years ago. He showed me some reamers which were made of short pieces of tool steel for the cutting portion, electrically welded to machinery steel shanks; an admirable arrangement apparently, and very satisfactory until they were turned and milled; and although the pieces were thoroughly annealed (?) several times it was almost impossible to turn or mill the portion of the steel where the weld was made, showing that the electric current produced some change in the chemical properties of the steel which made it similar to the self-hardening steels as far as not being "annealable" by ordinary processes. As also bearing on this subject, it may be in place to state that on a recent visit to the Pope Manufacturing Co., who installed a large plant for welding bicycle frames a few years ago, I learned that they have entirely abandoned it and have returned to brazing, owing to the hardening action of the current, which made the joint too brittle to be depended upon as the necessity of the work demands. So it seems that this system, which promised so much and which seemed to open a wide field for mechanical improvements, has serious drawbacks which have not as yet been overcome. There are many other interesting features in this modest but thoroughly modern shop, which will be mentioned from time to time.

* * *

It pays to keep the planer fixtures in place, the parallel blocks, wedges, stakes, etc., in good order and the nuts on the bolts where they belong. It takes a little more time to do this after you are through with a job, but saves far more time on the next one, for the next man has to hunt for every piece. Or, have a boy whose duty it is to look after the planer fixtures, keep them clean and in place ready for any one who uses the planer, or he can act in the same capacity for the regular planer hand if there is one.

THE MAN OF IRON.

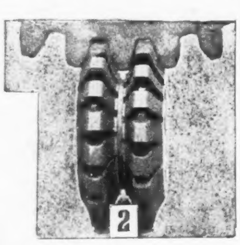


At this season of the year, when blood purifiers and tonics for "that tired feeling" are being consumed in quantities, it is refreshing to find a man, even if not clothed in flesh and pointed-toed shoes, who is not susceptible to the invasions of spring fever. This gentleman was born in Hartford and reared in the late cycle show in New York, under the supervision of Mr. Frederic C. Billings, superintendent for the Billings & Spencer Co., of Hartford, Conn. His make-up includes many branches of engineering; the steam engine, machinists' clamps, bicycle crank bearing cases and sprocket wheel being represented, while his head is completely "full of mechanical shapes and ideas." Although his friends say he is "looking thin" and needs a "little rest and change," he never misses a day in the office nor complains of fatigue or ill-health, and his general appearance indicates a long and prosperous career, unruffled by the changes of fashion or the price of suspenders.

* * *

THE EBERHARDT NEW GEAR CUTTER.

The accompanying engravings show a new patented form of gear-tooth cutter, which is being introduced by Gould & Eberhardt, of Newark, N. J., in connection with their Automatic Gear Cutting Machines. It will be seen that this system will increase the output with the same number of machines and men, according to the number of cutters that can be used in one gang; thus producing more finished work than it is possible to do in the same time with a single cutter. Although it has been declared that such cutters could not be made to work satisfactorily, the experience at the works of the manufacturers has shown that they can be used with entire satisfaction, and that they will cut gears very rapidly when used in a machine having sufficient power and strength.



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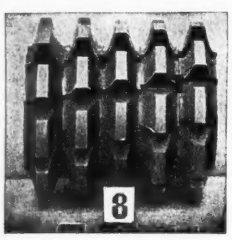
Gangs of these cutters have been made for finishing ten teeth at one passage of the cutter slide, the limit to the number of cutters that can be used in a gang depending largely on the pitch and size of gear to be cut. Each cutter is, however, made separately and "patent relieved," so that it can be ground upon the faces of its teeth without alteration of shape.



8

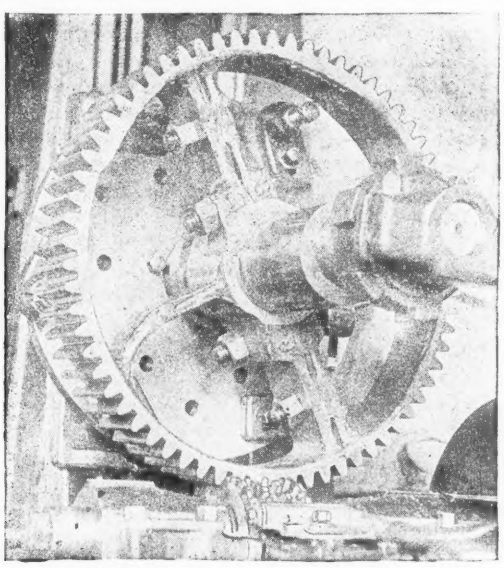
The larger view (page 11) was taken with a complete motor gear for street railway work on the machine, and shows four cutters in use, the first two on the left "roughing out," the other two finishing the teeth.

With this system, 10 inches to 40 inches of cutting per minute can be maintained without an effort and with ordinary help, making the use of the gears possible and more desirable where

gears with cast teeth were formerly used, also reducing the cost of cut gearing, formerly cut with but a single cutter.

Fig. 2 shows two cutters for gear work, and Fig. 8 a set for rack work with side-locking key way.

The cost of cutters is not excessive, and by having them set properly by a competent man, an ordinary workman can run as many machines as when a single cutter is used, as is the common practice in gear cutting. The fact that several users have



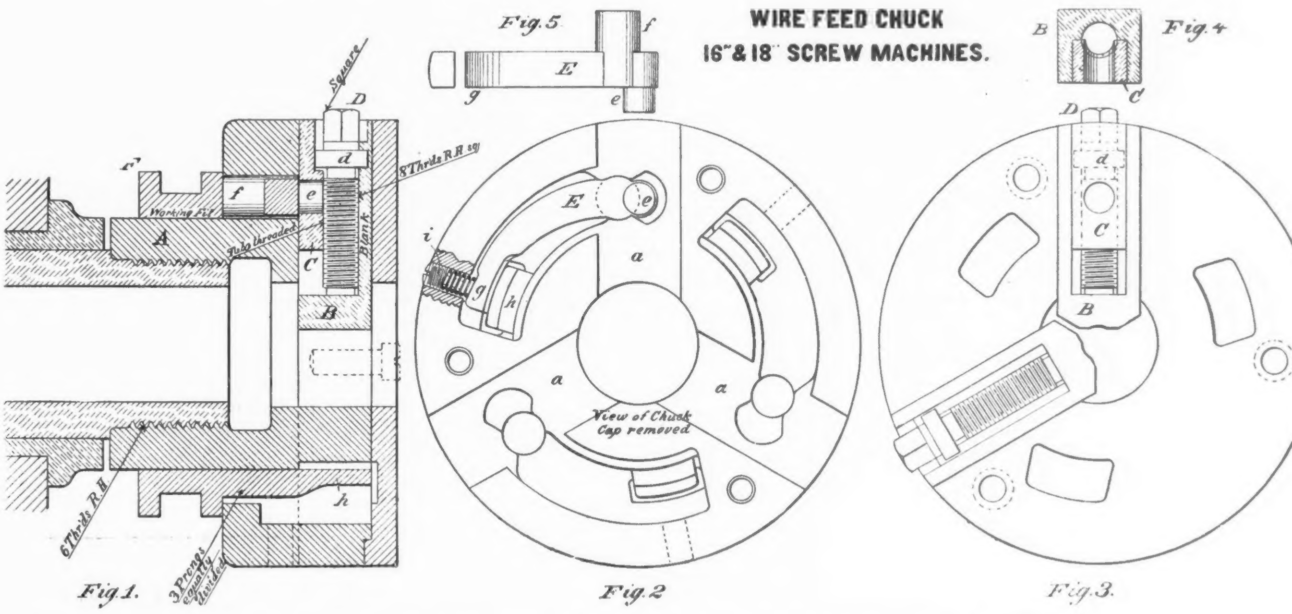
THE EBERHARDT NEW GEAR CUTTER.—SEE PAGE 10.

ordered duplicate sets, shows that their merit is better appreciated after actual use, as is often the case with any radical departure in machine shop practice.

* * *

NEW WIRE FEED CHUCK.

The accompanying illustrations show a new wire feed chuck designed by the Lodge & Davis Machine Tool Co., of Cincinnati, O., for use on their line of screw machines. The chuck and feeding device can be operated while the machine is running and takes in round, hexagonal or square stock from ½ inch to 2 inch without the use of collets. In Fig. 1 A represents the chuck body screwed onto the nose of the spindle, and having in front the radial grooves *a a a* for the jaws B. Jaws B are recessed on their back side to receive the blocks C. The screw D is placed in a semi-circular groove in B and kept from end movement by collar *d* and a suitable groove in the jaw. Block C forms a semi-circular thread for screw D, and is held in place by pivot *e* on lever E, Fig. 5. This lever, located in a cavity of the chuck body, swings on pivot *f*, eccentric to *e*, and it is obvious that by raising and lowering tail *g*, the jaws will make a slight in and outward movement, while by means of screw D each jaw can be adjusted independently. A collar F slides on the hub of the chuck body, and its taper-shaped prongs *h*, passing through suitable holes in the flange, enter under the tails *g* of the lever.

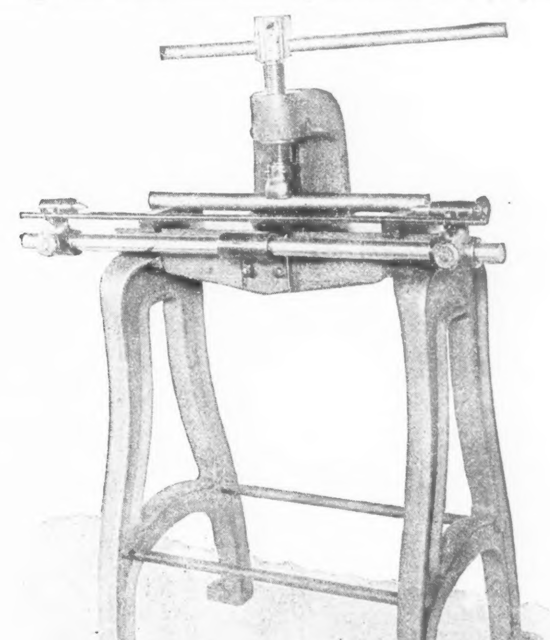


These levers are pressed down by springs *i* to open the chuck by the withdrawal of the pronged collar. This collar is operated by a ring and handle connected by means of a double lever and rod underneath the head stock to the well known feed arrangement of the Parkhurst type.

* * *

STRAIGHTENING MACHINE.

A well designed bed, 26 inches long, planed true; a rigid head carrying the straightening screw, centers for testing the truth of the work after using the press, and the whole mounted on substantial legs which can be bolted to the floor, completes the machine as a whole. The details, however, are interesting and deserve mention. Two V blocks slide to any desired position on the bed, for convenience on long or short bends. The bending block or follower on the end of screw has a projection at the back fitting a slot in the head, holding the follower in proper position



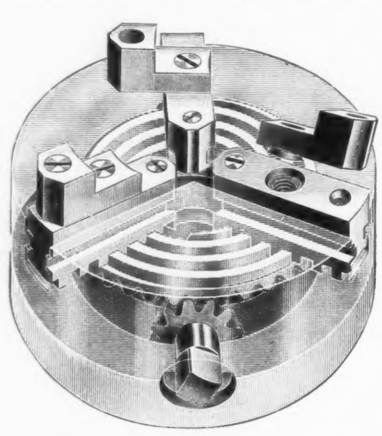
at all times. The upper end of screw is drilled so as to permit the use of two bars if the work requires the additional power. The screw is forged steel, cut with U. S. S. thread, 6 to the inch,

and will bend 2½ inch stock cold or 4½ inch red hot, and as work straightened by pressure is less liable to change its shape afterward, the machine should find a place in many shops. A light bar (½ in. steel) is placed in front of the testing centers for convenience in resting a pencil or piece of chalk when testing a piece of stock. The centers shown have a capacity of 30 inches, but this can be varied to suit purchaser. The centers are always in line, easily adjusted without wrenches, and the whole rest easily removed when not wanted. The right hand center is much like the tail-stock of a lathe, but is pressed forward by a spring so that a piece may be sprung in and out any number of times without disturbing the screw. The centers are hardened steel and are supplied with oil from a pocket in the head. This machine is being successfully used in a great variety of ways, straightening drills, taps, reamers, etc., as well as rough stock, and being solidly built (it weighs 390 pounds) will be found well adapted for heavy work. It is built by the F. W. Luscomb Machine Co., New Bedford, Mass., who will give any further information desired.

* * *

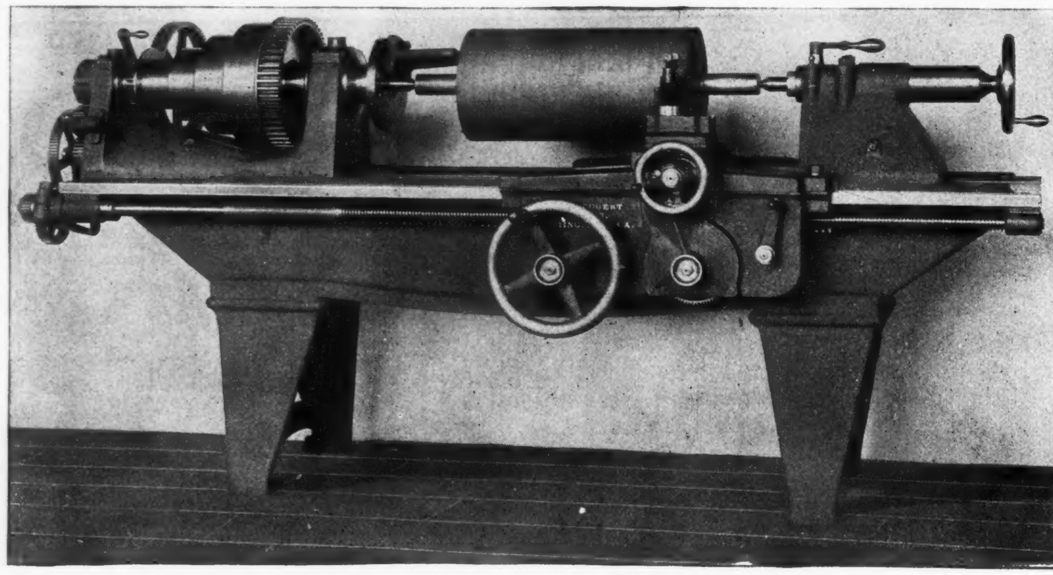
A NEW SCROLL CHUCK.

The cut shows a new geared scroll chuck recently brought out by the Union Manufacturing Co., of New Britain, Conn., which has several valuable features. The mechanic is particularly interested in the details of construction, and these are clearly shown. The jaws are moved and held by the geared scroll, which makes a strong and durable chuck, and as a convenience the jaws are made to swivel, changing from an inside to an outside jaw, with little time or trouble. This jaw is a feature of the chuck, for it is made practically solid in either position by the projection on the upper jaw fitting the recess in the main jaw and serving as a pivot, as well as locking it against end motion. This will recommend it to those who have been troubled with weak or loose chuck jaws.



BOGERT'S PATENT 20-INCH ENGINE LATHE.

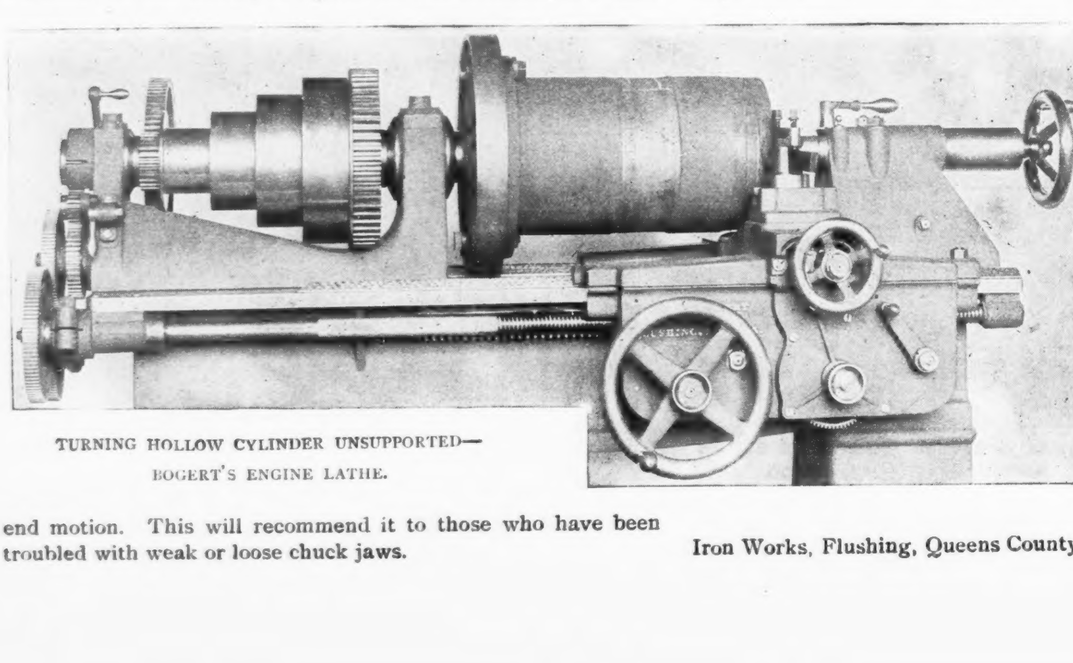
The first cut shows a cast-iron feed-roll for a saw-mill. The size of the drum or roll proper is 12 inches in diameter by 24 inches long. As these rolls come from the foundry, there is as much as ⅜ inch to $\frac{7}{16}$ inch of stock on a side to be removed, on account of the irregularity of the casting, although the diameter is not reduced more than ⅝ inch in finishing. During the last three years such rolls have been turned repeatedly, at the rate of a roughing and finishing cut over the convex surface of the drum, in 23½ minutes. If anywhere a greater extent of surface is being finished in the same time with single cutting tools, we are not aware of it. When done these rolls are not full of chatters, although the finish tool marks are 1 inch apart.



TURNING FEED ROLL—BOGERT'S ENGINE LATHE.

The second cut shows a casting 13 inches in diameter and 23 inches long, which is bolted fast to the face-plate by four ⅝ inch bolts through its flange, and unsupported in any other way. The distance from the middle of the front-bearing of the lathe spindle to the outer edge of this casting is nearly 30 inches. Under such conditions, the fact that a cut was run with a feed of six to the inch, nearly $\frac{3}{16}$ inch wide, with a depth of cut of $\frac{5}{16}$ inch in places and in others not an eighth, and that when calipered the work showed round and free from chatters, speaks volumes for this tool. It should be mentioned, furthermore, that the casting was 1 inch thick. The tail-block in no way supports the work, being set as far back on the bed as possible.

One of these lathes has been used continuously for more than a year on projectile work in a well known shop. In this place are some of the best makes of lathes in the country. It is interesting to compare the results obtained on one size of projectile shell—4 inch. These shells are made of .45 per cent. carbon, and the chips will harden. With any of the other lathes of corresponding swing the best result obtained was from thirty-three to thirty-five of these shells per day; with the Bogert 20-inch lathe, fifty per day. What better commentary could be needed, to show the folly of the remark, so often heard, "that one lathe is as good as another, if there is only plenty of iron in it"?



TURNING HOLLOW CYLINDER UNSUPPORTED—
BOGERT'S ENGINE LATHE.

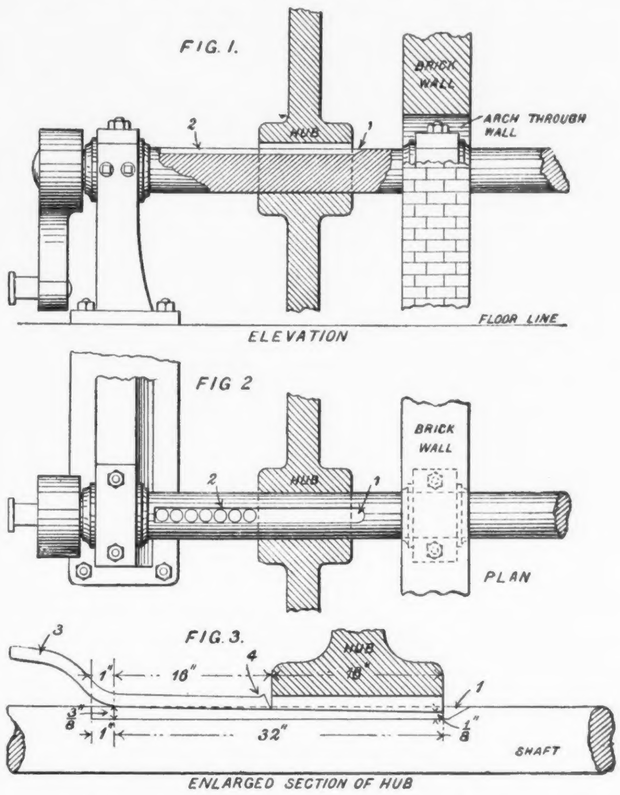
For further particulars concerning this machine and its work address Mr. John L. Bogert, Flushing Iron Works, Flushing, Queens County, New York.

HOW ONE THUMP WAS STOPPED.

William M. Francis.

To those who have not worked in a small machine shop, or who have always had a slotter to plane their internal key-ways, the following article may impart some information.

In these days of bustle in order to make a line of machines pay, it is to the manufacturers' advantage to have special tools and a special man for every form of tool. Thus we have lathe,



planer and bench or vise hands, who, when taken in their own line can work all around a general hand. On the other hand the general machinist who has worked in a small shop, who has been accustomed to take a casting or forging and follow the work through all its stages until put in the place designed for it, can sometimes manage by the use of an old idea to save considerable time and money for the person having the work done.

The owner of a shop might say, "I don't want a man to save other people's money; it is nothing in my pocket;" but in these days of competition the name or reputation of a shop is of some consequence. The man who has his mill put in order after a break down, quickly and cheaply, is apt to come back to have more work done, and also tell his friends where they can get proper treatment.

Having been sent out to a large State institution to locate a thump in a large "Corliss" engine, it was found that the thump could be located in almost any part of the engine, according to the part of the engine room you stood in. Those who have tried the same thing with an engine running, perhaps know that it's like looking for a cricket; when you get there it's somewhere else, or as the Frenchman said, "When you put your thumb on him he isn't there."

By blocking fly-wheel so that the engine was slightly off the center, so that when steam was turned on there would not be enough leverage to hurt anything and yet allow of a little circular motion if a key was loose in either wheel or crank, it was found after the crosshead, connecting-rod, etc., had been felt (while the engineer stood at the wrist-plate, quickly admitting steam first at one end of cylinder, then the other) that the key or feather in the hub of the fly-wheel had a slight rock to it. This in an engine with a variable load, that has the piston first driving the wheel and then the wheel driving the piston, will cause a pound hard to locate and will "get no better fast."

The cylinder having been recently examined, it was thought advisable to fit a new key and try the engine again. This would have been a simple matter but for the construction of the engine.

In a Government appropriation list, an appropriation can be more easily got if for repairs than for a new article. It was so in this case; this crank-shaft and fly wheel belonged to an ancient engine, and the cylinder, frame, etc., had been built to it. Upon examination it was found that a feather had been let into the shaft and the hub forced on over it, depending more on the fit on the shaft and fit sideways than top of key to make a tight job. The key-way then ended flush with the hub on both ends. It was now decided that as help was plenty, and as we did not know what snag we would strike if we attempted to dissect that fly-wheel, and as also every shop in the institution except the machine shop (which had separate power) was shut down, that the shaft would remain in place, and by taking off the eccentric (which was in halves) we had an inch or so more than the length of hub and length of key. An extension of the key-way was now laid out and spaced for $1\frac{1}{4}$ inch holes, drilled out to proper depth and intervening metal chipped out roughly, as shown at 2, Figs. 1 and 2. A little was then chipped out as at 1, Figs. 1 and 2, so as to admit of as large key drift as possible; the cap on the bearing in arch was then taken off to make room and the key drifted out. Upon calipering, the key was found as parallel both top and bottom and sideways as it could be made. Now in order to drive a key tight in a hub 16 inches long, the key should have at least $\frac{1}{8}$ of an inch taper in that length. It was now thought that the hub would have to go to the shop or be made tapering in the key-way, whether by planing or chipping or filing, in either case the shaft would have to come out.

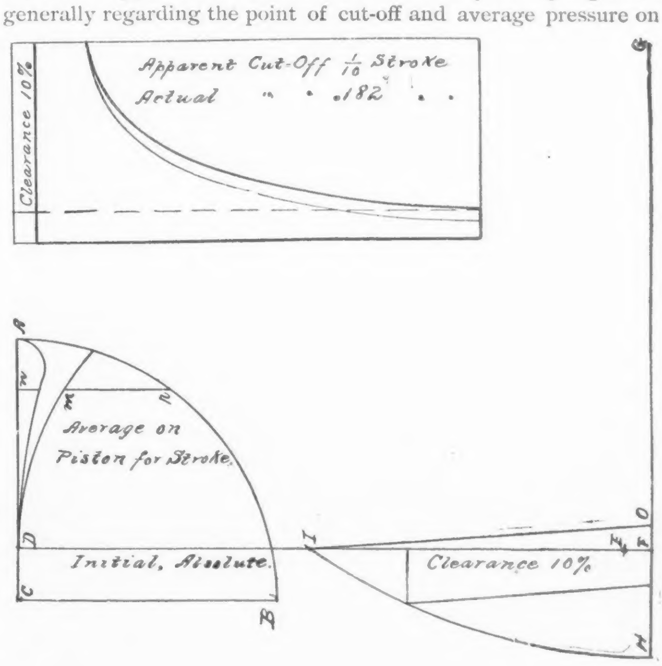
We now come to the part that small machine shop practice played. A piece of $1\frac{1}{4}$ by $\frac{1}{2}$ inch flat iron was now planed tapering $\frac{1}{8}$ inch at small end and $\frac{3}{8}$ inch at large end, as shown at 5, Fig. 3; it was made 1 inch short of the whole length of key-way and inserted hard against the end (1) Fig. 3. While this was being planed, a piece of $1\frac{1}{8}$ inch steel was being dressed and shaped into an obtuse cutting edged drift, as shown at 3, Fig. 3, so that the first time it was driven through it just scraped some off top of key-way in hub, and would not dig into the work. Before it was driven through again a slip of tin was inserted under the taper piece for feed, and then the drift was driven through again and again, inserting tin each time until the required taper was made from end to end. I neglected to say that after the drift went through, the taper piece was then shoved towards the $\frac{3}{8}$ end, thus freeing the drift so that it could almost be withdrawn by hand. Four, Fig. 3, is a cutting edge. The key had meanwhile been planed on three sides, the other side was soon planed and fitted, and the thump was cured.

* * *

AVERAGE PRESSURE ON PISTON.

N. J. Smith.

As there appears to be considerable uncertainty among engineers generally regarding the point of cut-off and average pressure on



the piston, perhaps a few words on this subject may be of benefit to some. While engineers and writers on steam, give many approximate methods for finding the average, but few have taken into account the loss of pressure on the piston for the stroke due to clearance. True it is that clearance gives a

higher average for the whole cylinder, owing to a smaller ratio of expansion, but the average on the piston is only for the stroke, and not for the stroke plus the clearance. While the apparent cut-off is the distance the steam follows the piston before valve closure, compared with the stroke, the real cut-off on which the average is calculated, is the distance the steam follows the piston before valve closure, plus the clearance in parts of stroke compared with the stroke plus the clearance. The greatest ratio of expansion that can occur in the cylinder of an engine is the stroke plus the clearance divided by the clearance, and this can only occur when the admission valve closes just as the piston begins to move; thus in a cylinder with 10 per cent. clearance, the greatest ratio of expansion that can occur is 11. The hyperbolic card illustrating this article is drawn with one-tenth of stroke as apparent cut-off, and 10 per cent. clearance. On a card taken by an indicator, as only the length of the stroke is given by the card, the average of the card gives directly the average on the piston for the stroke, that is, if the accompanying card could have been taken with an indicator, only the part included by the heavy lines would have been taken, which is the pressure acting on the piston for the stroke. The light expansion curve gives the pressure on the piston for the stroke for apparent cut-off, or without clearance.

A ratio of expansion greater than 10 is seldom met with in practice, except in calculating the horse power from the last cylinder of a compound engine, using the initial pressure of the high pressure and terminal of the last cylinder.

The following rule will give the average pressure on the piston for real cut-off with an error of less than one-fifth of 1 per cent., and for corrected pressure on this piston for the stroke with clearance up to 20 per cent. of stroke, with an error of eight-tenths of 1 per cent. Multiply 2 minus the cut-off by the cut-off; from the square root of the product subtract the square of eight-tenths minus the cut-off, multiplied by .215 plus 1⅜ times the clearance. Multiply the remainder by the absolute pressure.

Formula: $\sqrt{c(2-c)}-(1\tfrac{3}{8}\times \text{per cent.}+.215)(.8-c)^2$.

Example: Stroke 20 inches, apparent cut-off at 2 inches, clearance 10 per cent. of stroke=2 inches, gauge pressure 60 pounds; what is the average pressure on the piston for the stroke? (2+2)÷(20+2)=.182=real cut-off—(2—.182)×.182=.3308, sq. root of .3308 =.5771, .8—.182=.618 .618 square=.3833; .10×1⅜=.1375, .215×.1375=.352; .3833×.352=.1344; .5771—1.344=.4422×; 74.7=33.03=average pressure on piston for stroke.

Graphic method for finding the average pressure on the piston for stroke up to 20 per cent. clearance and cut-off greater than .1 stroke:

From *c* as a center draw the quadrant A C B. Let A C=the stroke plus the clearance, and C B=the absolute pressure. Make A C=40 on any convenient scale (⅛ inch=1 inch will make A C about the length of a card) C D=8, D E parallel to C B=95. From E as center with radius D E draw the curve for real cut-off without clearance, D F=99, F G 78. From G as center with radius D E draw the curve H I, make H O=20, draw O I: measure the percentage of clearance on the line H O, from H toward O. Draw from the percentage parallel to I O to the curve. From the intersection of the percentage line with the curve, draw a line to and perpendicular to D E. From the point where this line meets D E with radius to D draw the curve D *m*. Make A *n*=the real cut-off. Draw *n r* parallel to B C; the part of the line *n r* included between the curves is the average pressure on the piston for the stroke. The greatest error by this method occurs at about .7 cut-off and amounts to about ¾ of 1 per cent. Back pressure follows the same rules, and may be the subject of another article.

* * *

SYSTEM IN SHOP TOOLS.

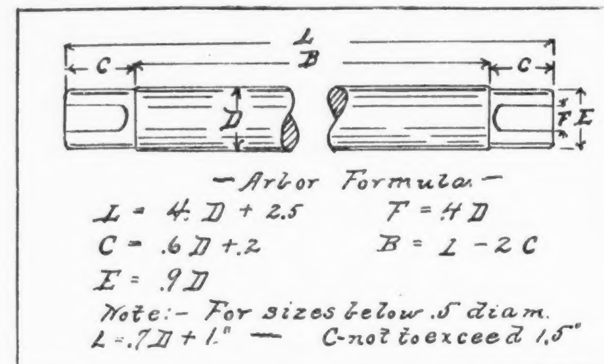
WARREN E. WILLIS.

In most shops where the outfit of small tools is not purchased from standard makers, but made as occasion demands, an observer will notice in looking over an assemblage of them, many which do not seem in harmony with others.

It does not follow that tools made in the shop where they are to be used need be badly proportioned or in any way inferior, but unfortunately it is too frequently left to the judgment of different individuals to decide upon the proportions of the tools they are to make. These decisions are likely to be modified by the finding of a piece of "scrap" that will be about right. The result is an incongruous collection of tools, far from being creditable to whoever may be responsible.

If a tool be worth making it is worth making well; if made well it will, when placed among its fell vs, look in conformity with them, not made by chance, but by design, appearing right to the eye of a mechanic and being capable of doing good service.

No good reason can be given for lack of uniformity; if the



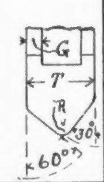
proper length of an 1¼ inch arbor is 7½ inches, certainly one-half that diameter should not be as long, yet these bad examples are frequently met with, all for the want of a little forethought in preparing a system for the tool-maker's guidance.

To make a reform in this respect which will gradually cover all the small tools, it is only necessary to decide upon the range of sizes likely to be used and the proportions of the extreme sizes, as by graphical methods all of the others can be readily found.

To illustrate: Suppose a shop decides to make one or more of a set of arbors; it is thought that a range from ½ inch to 2 inches,

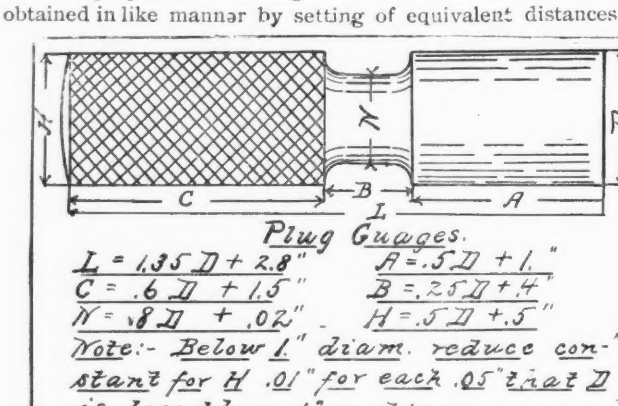
Combined Tap & Reamer Cutter.

Number	Small end of Reamer	Large end of Reamer	Teeth	Diam. of Tap Small	Diam. of Tap Large	Grooves	Teeth in Cutter	Depth of Teeth	Diam. of Cutter	T	G	R
1	1/8	1/4	6	0	1/8	4	16	.15	1.75	.125	.046	.0125
2	9/32	3/8	6	5/32	1/4	4	16	.15	1.75	.187	.062	.0250
3	13/32	1/2	6	9/32	3/8	4	14	18	1.87	.312	.078	.0375
4	17/32	1 1/8	8	7/16	5/8	4	12	24	2.00	.437	.109	.0625
5	1 5/32	1 3/4	10	11/16	7/8	4	12	28	2.12	.562	.125	.0875
6	1 25/32	2	12	15/16	1 1/4	4	10	36	2.25	.750	.156	.1250



by 16ths, will be required. By observing the proportions of some good examples or making a few sketches, it is determined that the ½ inch should be 4½ inches in length, and that the 2 inch should be 10½ inches long. Draw a base line, divide it equally by twenty-five vertical lines, one for each sixteenth; make the length of one extreme vertical line 4½ inches, the other 10½ inches; join these two by a straight line and number the shortest ½, the others 9/16, ⅝, etc. The entire length of any size can be readily found by measuring the line numbered correspondingly.

Other proportions, as length and diameter of ends, may be obtained in like mannar by setting of equivalent distances and



connecting the points thus determined upon. This system is applicable to all small tools, as arbors, counterbores, milling-cutters, drills, gauges, taps, reamers, wrenches, etc.

Annexed are examples of the graphical method of formulæ, which may be worked out by those who prefer it, and of plain

"shop talk" cards, about which there can be little misunderstanding.

All small tools are to be made with their proportions as per

SCHEDULE.

ARBORS.
The entire length is equal to 4. times the diameter plus 2.5 inches.
" length of end " " " .6 of " " " .2 "
" diam. " " " " " .9 " " " "
" flat " " " " " .4 " " "
For sizes below .5 diame er.
The entire length is equal to 7. times the diameter plus 1. inch.
Note.—In no case is the length of ends to exceed 1.5 inches, or be less than .4 inch.

BURR REAMERS.
The entire length is equal to 7. times the diameter plus 1. inch.
" length of cut " " " 4. " " "
" diam. of neck " " " .9 " " "
Note.—On all sizes above .5 inch the shank is to be taper, and the length considered from the part extending from the coller.
Intermediate sizes below .5 to .375 have 1. of straight shank .375 in diam.
" " " .375 " .25 " 1. " " " .30 " "
" " " .25 " .20 " 1. " " " .25 " "
" " " .20 " .16 " 1. " " " .20 " "

COUNTERBORES.
The entire length is equal to 7. times the cut diam. plus 1. inch.
" length of cut " " " 1.5 " " " " " .1 "
" " of pilot " " " 1. " " pilot " " .05 "
" diam of neck " " " 1. " " " " " ½ difference between diameter of cut and pilot.
Note.—In practice the diameter of pilot will vary in proption from the diameter of cut, so no rule can be given to suit all circumstances.
Se note on Burr Reamers for consideration of shanks.

PLUG GAUCES.
The entire length is equal to 1.35 times the diameter plus 2.9 inches.
" length of plug " " " .5 " " " " 1. "
" " " neck " " " .25 " " " " .4 "
" " " handle " " " .6 " " " " 1.5 "
" diam. " " " " " .5 " " " " .5 "
" " " neck " " " .8 " " " " .02 "
Note.—On sizes where the plug is less than 1. inch in diameter. divide the difference between the required diameter of gauge and 1. inch by 5 and subtract this quotient fr m the results obtained by above formula; the remainder will be the correct size for handle.
Where the plug is greater in size than 1. inch, follow the above to obtain the correct sizefor neck.

* * *

WHAT MECHANICS THINK.

THIS COLUMN IS OPEN FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE. WRITE ON ONE SIDE OF THE PAPER ONLY, AND BOIL IT DOWN.

WHEN SKETCHES ARE NECESSARY TO ILLUSTRATE THE IDEA, SEND THEM ALONG—NO MATTER HOW ROUGH THEY MAY BE, WE WILL SEE THAT THEY ARE PROPERLY REPRODUCED.

THE USE OF ECONOMIZERS.

I read with interest Mr. W. Barnet Le Van's paper on "High Chimneys," and although I agree with him on many points, I beg to take exception to his remarks on economizers. He states: "The adoption of a first-class boiler properly set in brickwork, connected to a high chimney, renders the use of an economizer unnecessary. The cost of fans or blowers, and the wear and tear of them and the boiler, far exceeds the extra cost of a high and properly constructed chimney." From these remarks Mr. Le Van evidently thinks that an economizer can only be used successfully with forced draft, but this is not the case at all, as 95 per cent. of the thousands of economizers that are working successfully to-day in Europe and in this country, are connected to chimneys direct, without any mechanical means of assisting the draft. In any well designed plant with first-class boiler and chimney, large enough to give them ample draft to burn any kind of coal that may be used, an economizer can be installed and will increase the efficiency of the boilers from 10 to 15 per cent. Some of the largest street railroad plants and sugar refineries in this country and Canada have been using economizers connected to chimneys, without any mechanical means of increasing the draft, for years. As the higher pressures gradually come into use the value of economizers will increase, as the temperature of the gases leaving the boilers will consequently be higher, and the fact is evidently being recognized by engineers to-day from the number of street railroads and large manufactories adopting them. As by the use of the economizer with a high chimney a saving of 10 to 15 per cent. can be made in the fuel consumed by the boilers, it is worth the consideration of any large steam user to put them in. This saving is effected by heat which otherwise would go to waste, and as an investment it is about as profitable a one as can be made on any steam plant, where they are working with a high chimney.

Matteawan, N. Y. A. H. BLACKBURN.

A COUNTERBORE.

Of all the tools continually used in a machine shop the counterbore is probably the source of the most inconvenience. That is, the counterbore as it is usually found in jobbing and repair shops, those forged and machined in one piece, one by one as necessity has required them, the most of which have subsequently been "ground down" to do work other than that for which they were originally intended.

The objections to such an equipment need not be enumerated here, as every machinist of a few years' experience is thoroughly familiar with them. What is wanted in such shops is a set of counterbores which will answer all practical requirements, *i. e.*, counterbore any hole to any size within certain limits (the less limited the better), be rigid, easily and quickly adjusted to different requirements, and last but not least, be made and maintained with a reasonable outlay of labor and material, which, summed up, means money. I have as yet to see this subject get an overhauling in a mechanical paper, and to set the ball in motion I submit the following, which is as near as I can approach the conditions above mentioned, for consideration and, if you have something better, condemnation.

Referring to sketch, Fig. 1 represents shank with slot to receive cutters, upon which is fitted a left-hand knurled hand-nut, which is shown in section at A. The pilot is to be threaded but half its length, as shown at *b*, so that it may be used without bushing and without injury to threads, and is flattened at *c* to the width of slot so as to bring cutting edge of cutter in contact with pilot when slot is cut in cutter with a mill or planing tool as at *a*, Figs. 3 and 4. Fig. 2 shows bushing for pilot, of which, of

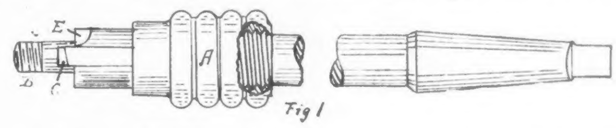


Fig 1

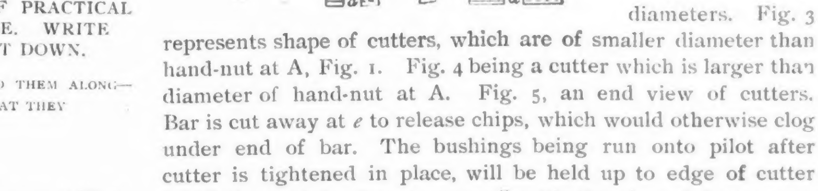
course, there must be several with various outside diameters. Fig. 3 represents shape of cutters, which are of smaller diameter than hand-nut at A, Fig. 1. Fig. 4 being a cutter which is larger than diameter of hand-nut at A. Fig. 5, an end view of cutters. Bar is cut away at *e* to release chips, which would otherwise clog under end of bar. The bushings being run onto pilot after cutter is tightened in place, will be held up to edge of cutter by friction and be free to run off with thumb and finger upon cutter being released. Two, or at most three, sizes of shanks would be sufficient to meet all requirements of an ordinary shop. These shanks once made, the rest is of but little consequence, as a dozen or more cutters of various lengths could be slotted to receive pilot at one setting in a milling machine or planer, and would take but a few minutes to insert each in the shank which will drive it and turn them to size, after which five minutes filing will make each ready for tempering.

I have not materialized this tool as yet, and know of no others having tested it. Should it have been "tried and found wanting," a statement of experience with it would probably be found beneficial to those who contemplate making this or a similar device. A little indulgence on the part of MACHINERY in the way of space, and a little devotion to the subject on the part of a few men of successful counterbore experience, would, I think, be of considerable value to its readers. T. E. BARKER.

* * *

A NEW PIPE WRENCH.

Plumbers, steam-fitters and others who have occasion to use a pipe wrench will be interested in the new tool made by Samuel Hall's Son, 229 West Tenth street, New York city, which we illustrate as a screw wrench.



This is almost self-explanatory, but it may be said in addition that it is constructed throughout of crucible steel, drop forged, and is as durable as it is simple. The jaws are smooth instead of being corrugated, and will not mar a nut or highly polished fitting. It is quickly adjusted to different sizes of pipe, and grips quickly and firmly all kinds, galvanized as well as other pipe, and will not crush it. It releases instantly and *cannot lock* on the pipe. It can be sharpened on any grindstone or emery-wheel without being taken apart.

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During the last five years there has been a great improvement in the passenger service between the North and the South. The reorganization of the Richmond & Danville and East Tennessee, Virginia & Georgia systems, under one grand system, known as the Southern Railway, has given the South a service that to-day equals any on the American Continent. The Southern starts at Washingtou, D. C., and extends through eight Southern States, touching about every important Southern city over its own rails, operating from New York city. Three daily limited trains with ten different sleeping car lines throughout the South. Dining cars on all of its limited trains. "The Washington and Southwestern Vestibuled Limited," between New York and New Orleans, and "The New York and Florida Short Line Limited," between New York and St. Augustine, are two of its fast limited trains which have a national reputation. These trains are most luxuriously equipped, carrying dining, drawing room compartment sleeping cars. The large patronage which the Southern receives of the travel between the North and South is evidence that the superb service offered by the greatest Southern system is appreciated by the traveling public.

Those contemplating a trip can procure descriptive matter of the route by calling at or addressing 271 Broadway, New York.

* * *

MANUFACTURING NOTES.

THE GARRY IRON AND STEEL ROOFING CO., of Cleveland, have about completed the new plant of the United Salt Co., furnishing all the material and erecting the entire plant.

MESSRS. SCRANTON & CO., New Haven, Conn., report a large sale of their power hammers, and announce a new circular giving considerably reduced prices.

THE TAYLOR-RICE ENGINEERING CO., Wilmington, Del., report a fair business in regular lines, but special work is so brisk that larger shops are a necessity.

CHAS. A. STRELINGER & CO., Detroit, Mich., report that they are very busy and indications point to a good season.

FRESH FROM THE PRESS.

LITTLE LEAKS IN THE PATTERN SHOP, is the name of a booklet just issued by Smith's Pattern Works, Akron, Ohio. It will be mailed on application.

D. VAN NOSTRAND CO., New York, have just issued a revised edition of their catalog of books, which is very handily arranged by subjects, so as to enable any book to be easily found. It will be mailed free to any address.

THE VAN AUKEN STEAM SPECIALTY CO., C. P. Monash, Manager, 201 Canal street, Chicago, have issued catalog A for 1895, showing their specialties in the shape of automatic air valves for radiators, steam traps, pressure regulators, pump governors of various styles, low water alarms, etc. Engineers will be interested in the line shown.

LOCOMOTIVE CATECHISM; Robert Grimshaw. 362 pages. $2.00. Norman W. Henley & Co., New York. The man in the railroad shop, the fireman, or even most engineers, can learn something from this book, as it contains questions and answers which have probably never occurred to many of them. Compound engines receive considerable attention, and some of the supposed mysteries of this type of an engine is made clear. Valve motions, which are always a source of discussion with engineers; air brakes, injectors and feed pumps are among the many subjects dealt with in a concise manner. The increasing demand for the book speaks more for it than a review can.

THE P. H. & F. M. ROOTS CO., Connersville, Ind., issue a neat catalog for 1895, showing the details and improvements of their blowers, as well as their capacities for cupola work. Lettered drawings and tables give the principal dimensions of the different styles, and the catalog as a whole contains much of value to those interested in this line of work.

THE NICHOLSON FILE CO., Providence, R. I., send us a miniature edition of their large catalog, mentioned a short time ago, showing the different styles and sizes of files made by them, which will be valuable to mechanics generally. We believe the small catalog will be sent on application.

RIEHLE BROS., Philadelphia, Pa., whose testing machines are well known, have issued a nicely printed catalog of 122 pages, 9½ by 12 inches. Illustrations of card diagrams, as recorded by the Riehle Autographic Testing Machine, are shown, as well as half-tone illustrations of the latest machines. There are concise directions for operating the machines, which will be valuable to those interested in this work. Cement testing also receives attention, and the catalog will be appreciated by those for whom it is intended.

THE HILLES & JONES CO., Wilmington, Del., send a new catalog which attracts attention by its novel cover designs, representing a boiler-plate with various openings punched with machinery built by this firm. The engravings are about "half and half," half-tones and wood-cuts, the former showing their superiority for this kind of work, presenting the machine just as it really is, and having a much neater appearance. Some of the tools shown are entirely new, others the well known product of this firm, whose work in the line of heavy shearing and punching tools needs no introduction.

THE HOGAN BOILER CO., Middletown, N. Y., send us a collection of twenty-five plates, showing, by half-tones and line work, some of the boilers of this company, in various stages of erection, in operation, and the details of connections and construction. It is almost a "story without words," as only the titles are given on the plates, the rest being explained by the engravings. It is a novel and interesting form of catalog.

IN the "First Annual Directory of Wholesale Hardware Dealers in the United States," to be issued about May 1st, Mr. D. T. Mallet, publisher of the "Hardware Dealer," 78 Reade street, New York, will give us something that has long been needed. There will be about a thousand names, besides a supplement with the leading ironmongers of Great Britain. The price will be 25 cents, but it is intended principally for free distribution in the interest of the "Hardware Dealer."

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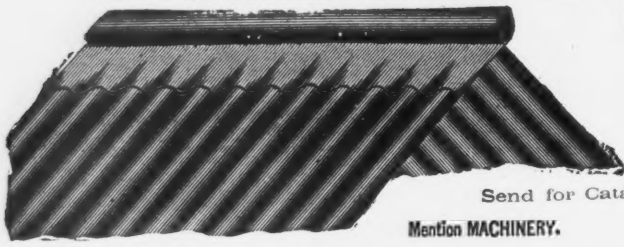
nothing but Corrugated Ridge and Hip Capping for Corrugated Roofing.

Saves Corrugated Wood Strips, Saves Time, Saves Money. Furnished to fit different corrugations.



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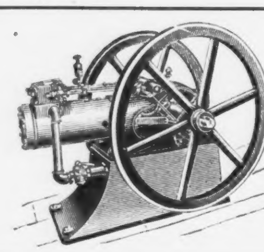

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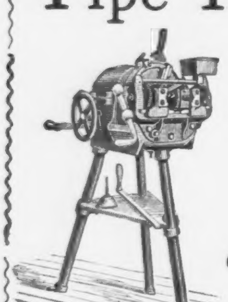

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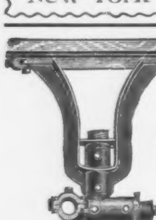

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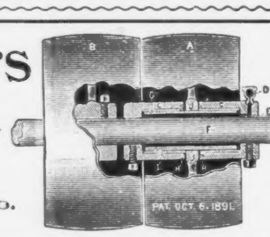

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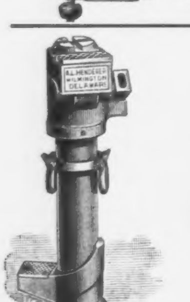

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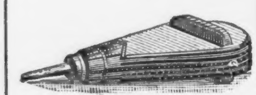

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Surface Grinders
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A good, serviceable Ratchet at a very low price. The taper hole is an exact fit for the Morse Twist Drill Co.'s, The Cleveland Twist Drill Co.'s, and the Standard Tool Co.'s 3/4 x 5/8 x 1 1/8 inch Taper Square Shank Drill. Send for Circular.

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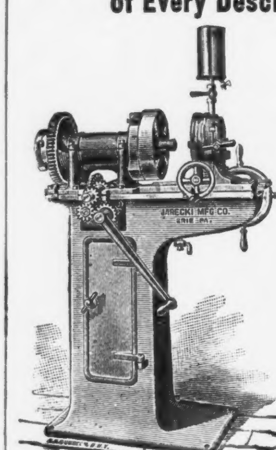

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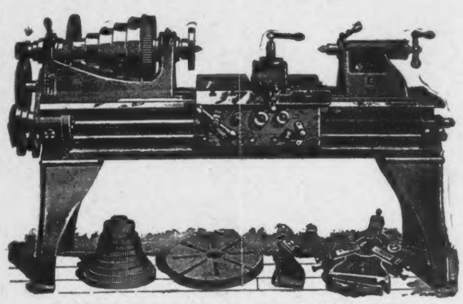

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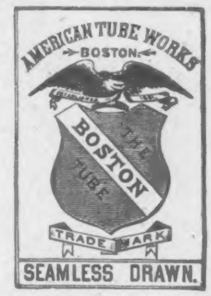

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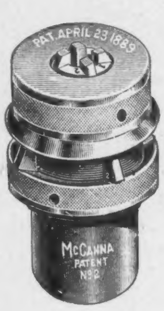

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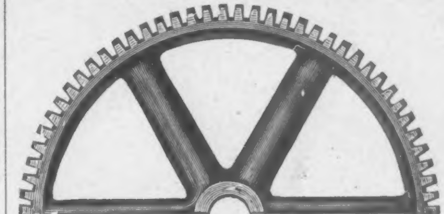

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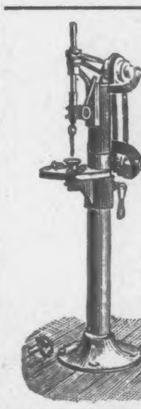

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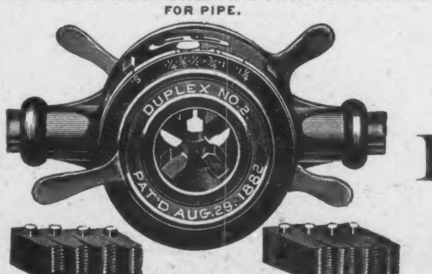

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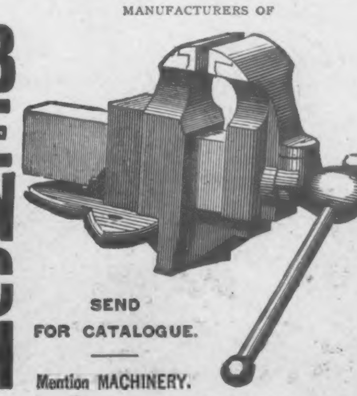

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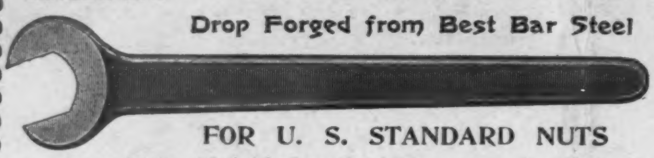

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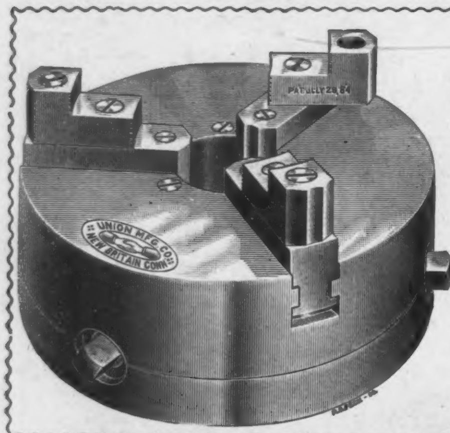

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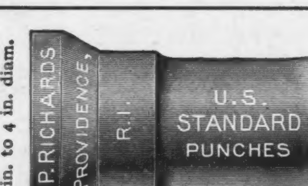

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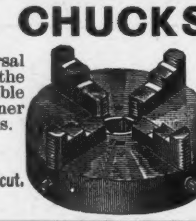

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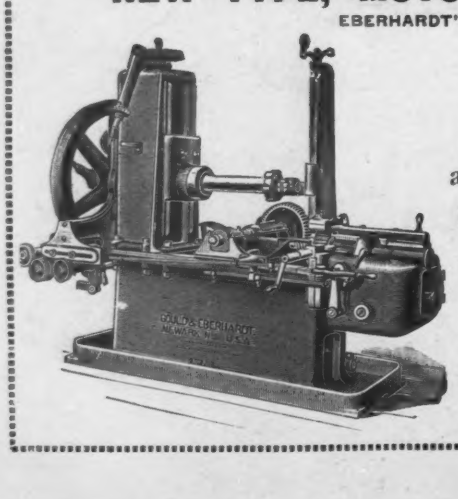

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